

Electronic Design[®]

A HAYDEN PUBLICATION

FOR ENGINEERS AND ENGINEERING MANAGERS — WORLDWIDE

OCTOBER 31, 1984

1984 Career Survey: Despite high salary levels, engineers are not wholly satisfied

**Personal Computer Series:
Personal instruments grow to measuring maturity**

Product Report: Precision op amp ICs reach new 'lows' in input traits

12-bit a-d chip runs on 5 V, interfaces easily on analog and digital sides

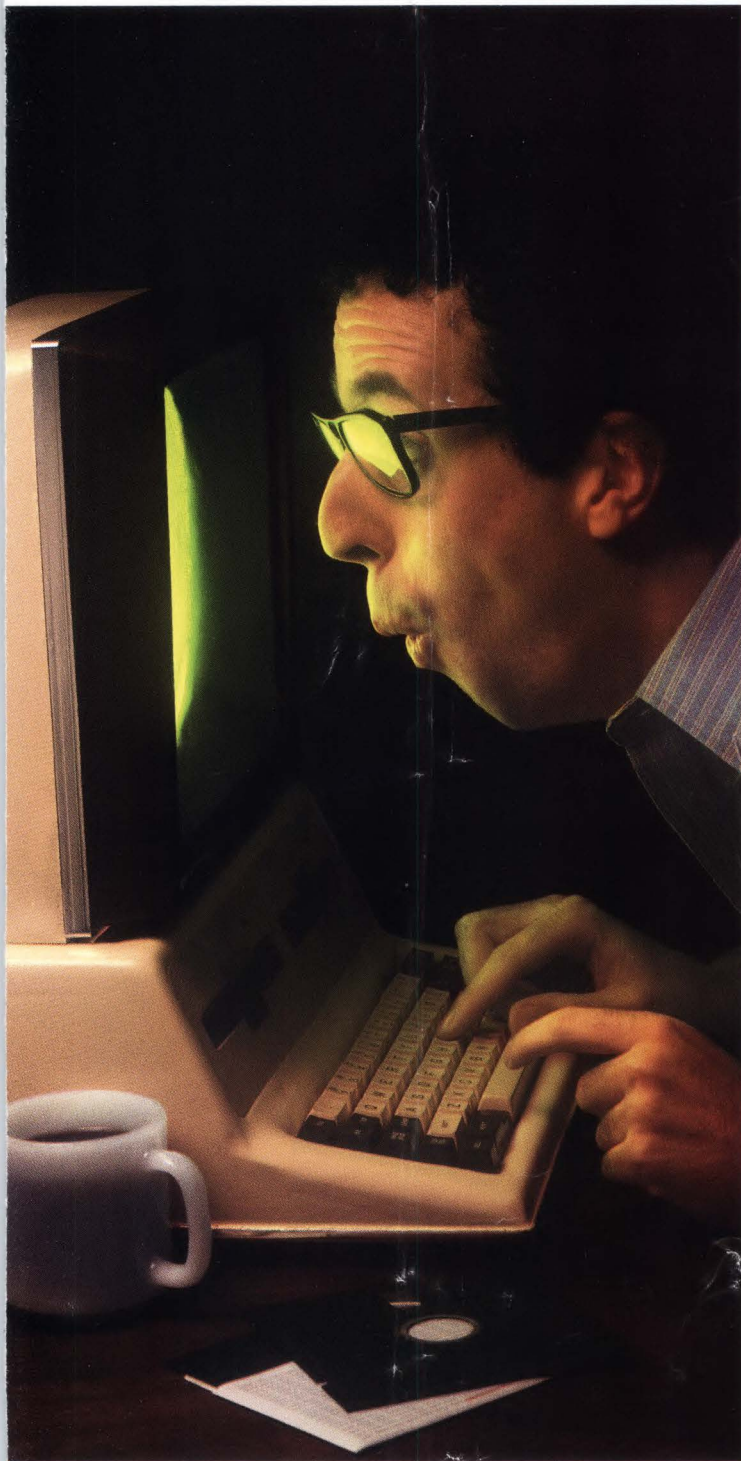
**Single-chip
systolic array
brings
new
dimensions
to processing
data**

40
DIR
279 DD*
DD*

MA 02238

BBN COMM
50 MOULTON ST
CAMBRIDGE

AMD YOUR CRT.



AMD's CRT controller family wrings every last drop of performance out of your video screen.

You get a dazzling, attractive display your customers will find irresistible.

The Am8052. You'll wonder where the flicker went.

Thanks to on-board DMA and triple row buffers, you get vertical and horizontal split screens, with smooth-scrolling windows. All flicker-free.

You even get double-height and double-width characters, superscripts and subscripts.

The Am8152A/53A. Make your display look its sparkling best.

You get cleaner, crispier characters with the 100MHz video system controller. And proportional spacing down to two pixels.

No other VLSI chip set gives you as much.

And to top it off, the chips even take over many of the functions of the CPU. Like linked list manipulation for easier editing. Your CPU has better things to do.

We'll put you as far ahead of the competition as we are.

Controllers. Bipolar and MOS microprocessors. Communication circuits. Signal processors. Nobody makes as many peripherals for as many microprocessors as AMD.

And every single chip meets or exceeds the International Standard of Quality.

The International Standard of Quality guarantees a 0.1% AQL on all electrical parameters, AC and DC, over the entire operating range.

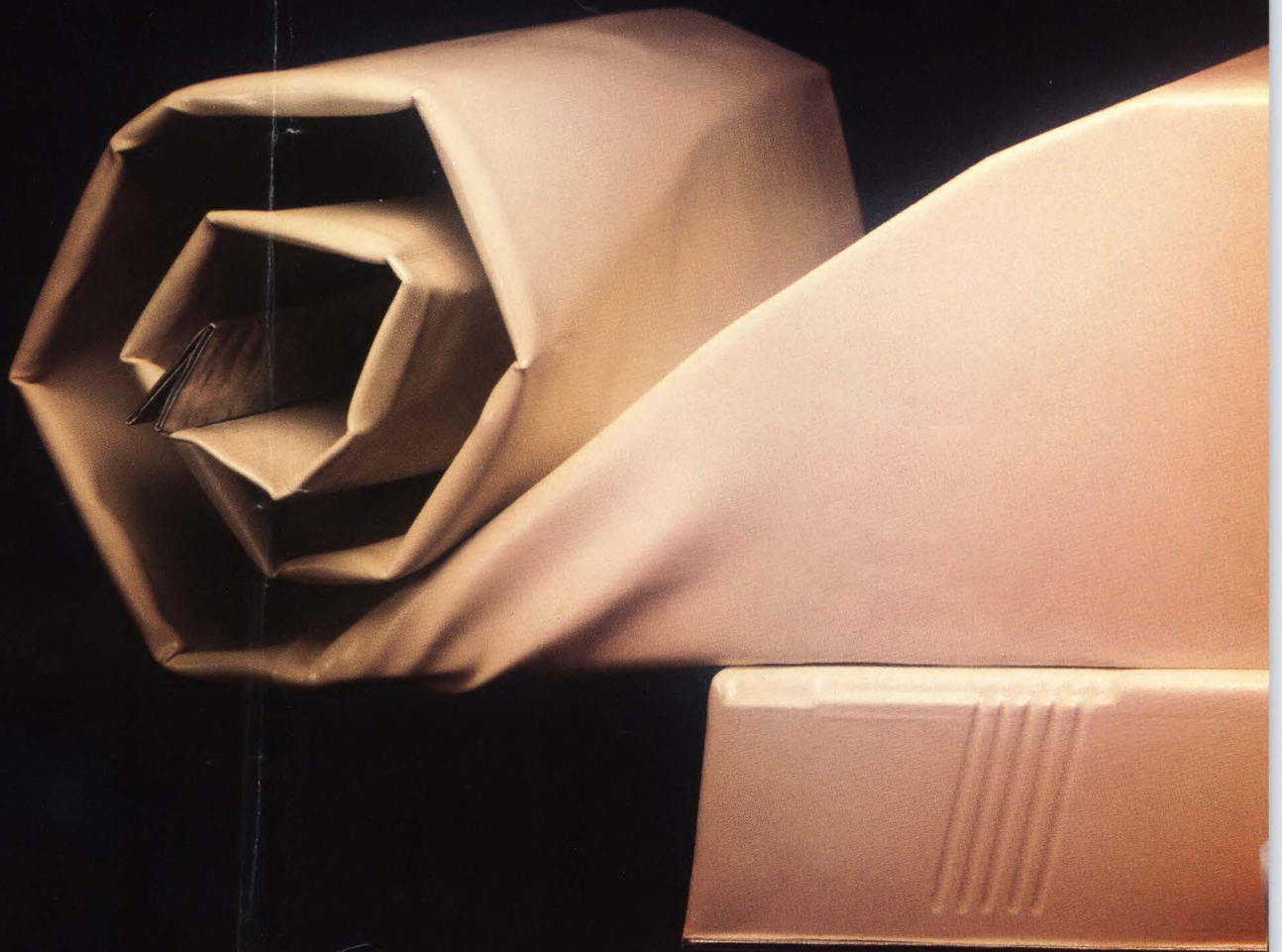
INT-STD-1000

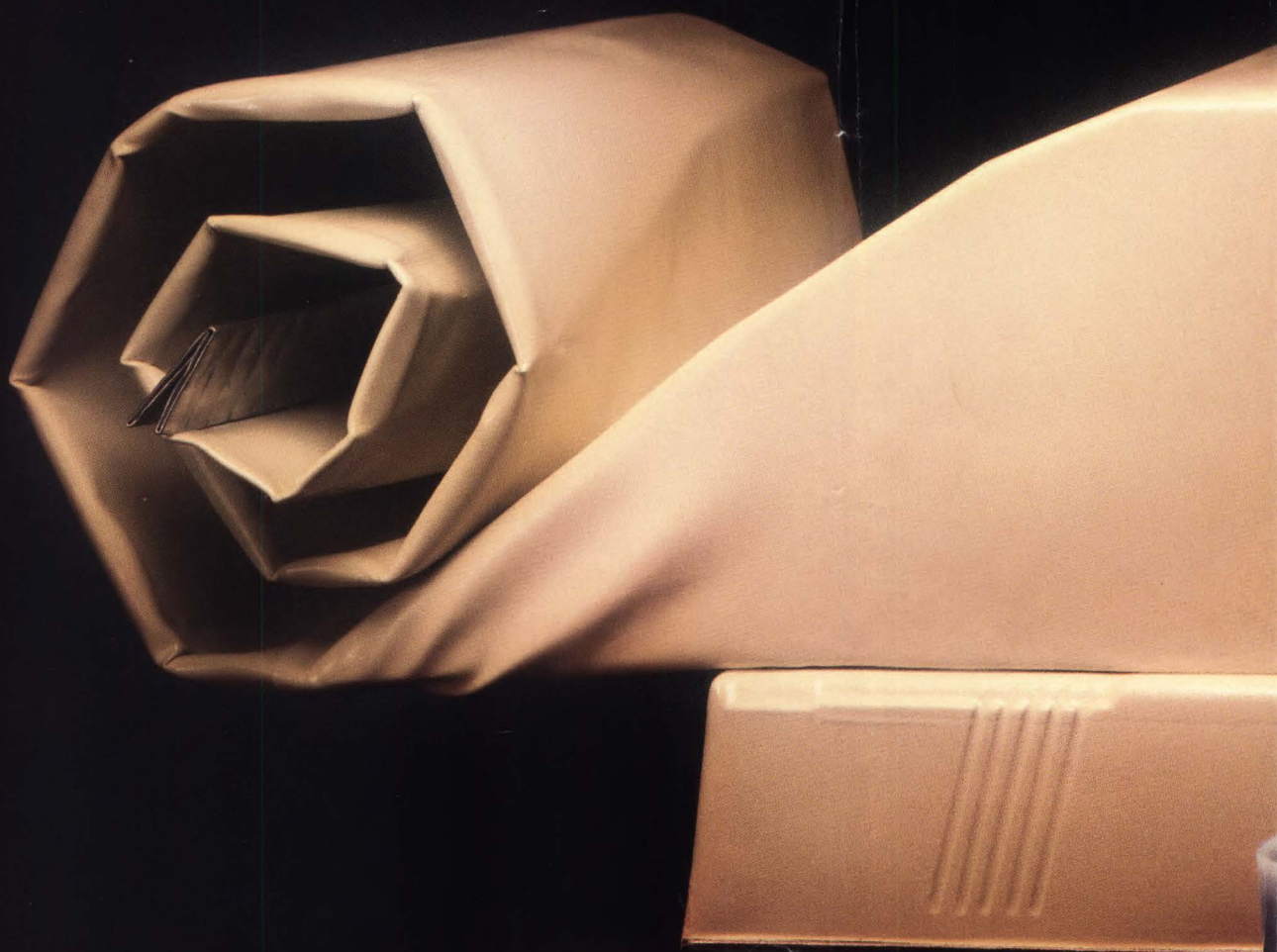
If you want the most out of your tube, put the squeeze on AMD. We'll show you several ways to put the sparkle in your customer's smile.

Advanced Micro Devices

901 Thompson Place, P.O. Box 3453 Sunnyvale, CA 94088
(408) 749-5000, outside California, call toll-free (800) 538-8450, Ext. 5000.

Squeeze more out of the tube.





© Advanced Micro Devices, Inc. 1984.

Solutions



**High power
on a low budget.**

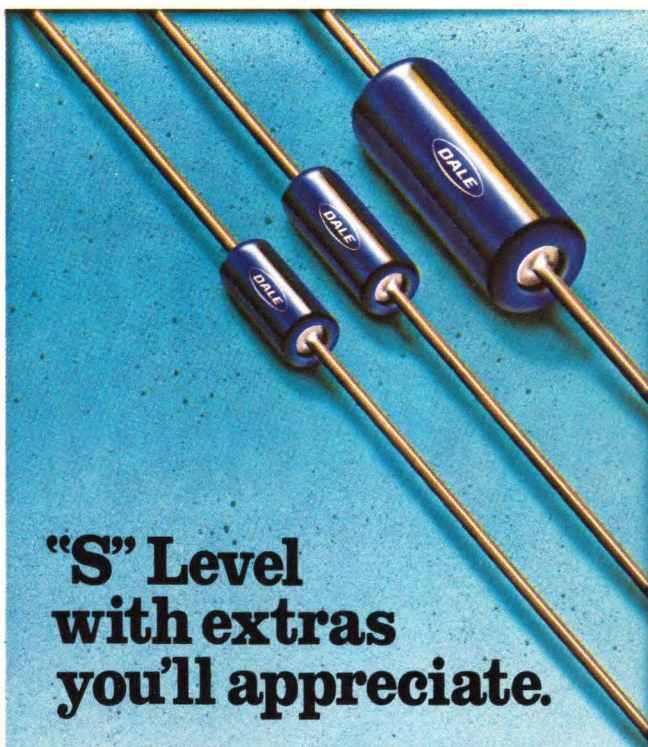
Dale's HLW.

Our HLW resistors are a cost-saving way to dissipate power from 3 to 20 watts. You get quick, easy board insertion, long-term wirewound stability, standard resistance as low as .1 ohm — plus fast availability from stock. HLW's are just part of a versatile family of Dale silicone-coated industrial wirewounds with power capabilities to 300 watts. They offer a variety of termination options and are available in tapped and adjustable models. For all your power handling needs, contact our experts at: Dale Electronics, Inc., 2064 12th Ave., Columbus, NE 68601

For more details, call: **402-564-3131**

See us at Electronica, Booth 14-C-26.

CIRCLE 3



**"S" Level
with extras
you'll appreciate.**

Dale's SE.

We deliver metal film resistors that do more than just meet MIL-R-55182 for "S" level hermetically sealed parts. Our SE styles use patented construction to provide superior performance and environmental characteristics. And, our extensive factory and distributor stocking program makes them available faster in RNR55, 60 and 65 styles. Find out about our complete capability to develop specific reliability programs to your requirements. Contact: Dale Electronics, Inc., 2300 Riverside Blvd., Norfolk, NE 68701

For complete information: **402-371-0080**

See us at Electronica, Booth 14-C-26.

CIRCLE 4

Dale makes your basics better.



ROCKWELL SEMICONDUCTOR TECHNOLOGY CREATES THE NEXT GENERATION OF INTEGRAL MODEMS.

Our third-generation VLSI capabilities give you support at any level.

Building modems into your product line used to be a complicated and costly process. But Rockwell International's latest generation of VLSI integral modems is changing all that.

Today, our VLSI capabilities mean that we can support your design requirements at any level: you can order VLSI chip sets; standard cards with all data rates interchangeable; or custom cards designed to fit your specific shape, connector and software integration requirements.

In fact, we can offer a simple, economical solution to virtually any application requirement from 1200 to 9600 bps. Since our modems include both a microprocessor bus and an RS232C interface, they can be easily designed into computers, from micros to mainframes; plus G2-G3 facsimile machines, multiplexers, terminals and, of course, box modems.

What's more, Rockwell is the only supplier of full-duplex, dial 2400 bps VLSI integral modems.

And all of our modems are as reliable as they are versatile. Based on our customers' experience with over a half million Rockwell integral modems in use around the world, we've been able to document an MTBF of 200,000 hours—nearly 23 years between service calls. Performance-wise, transmission is virtually error-free over unconditioned or dial-up phone lines because our integral modems offer auto-adaptive equalization.

We are the world's largest supplier of high-speed modem subsystems and devices. Ask your sales representative or distributor for a quote today, and you'll see that we have a distinct advantage in price and delivery lead times, too.

Rockwell integral modems. A generation ahead of all the rest.

Rockwell Semiconductor Products Division

Rockwell International, P.O. Box C,
MS 501-300, Newport Beach, CA
92660. Call toll free (800) 854-8099.
In California: (800) 422-4230.



Rockwell International

...where science gets down to business

ElectronicDesign

Editor-in-Chief: Lucinda Mattera

Executive Editor: Stanley Runyon

Managing Editors:

Michael Riezenman, *Technology Report*

Margaret Eastman, *Design Entries*

Warren Andrews, *Technology News*

Michael Robinson, *New Products*

Editor-at-large: Martin Gold

Associate Managing Editors:

David Bursky, *West Coast*

Roger Allan, *Special Features*

Executive Art Director: Thomas Phon

Senior Editor: Max Schindler

Technology Editors:

Analog & Power: Frank Goodenough

Communications & Industrial: Roger Allan

Computers: Mark Brownstein

Computer Peripherals: Stephan Ohr (Sunnyvale)

Instruments: Robert Milne

Semiconductors: David Bursky (Sunnyvale)

Software: Max Schindler

Field Editors:

East Coast: Carole Patton (Hasbrouck Heights);

Gary Elinoff (Boston)

West Coast: Curtis Panasuk (Sunnyvale);

Ray Weiss (Los Angeles)

Midwest: Terry Costlow (Chicago)

South: Heather Bryce (Dallas)

Europe: Mitch Beedie (England)

Associate Editor: Gil Bassak

Design Solutions Editor: Harold Winard

New Products Editor: Susan Nordyk

Chief Copy Editor: Diane Tunick-Smith

Copy Editors: Aaron Fischer, Ellen Muraskin, Teresa Meola

Editorial Production Manager: Anne Gilio Turtoro

Assistants: Donna A. Carullo, Catherine Wolf

Assistant Art Director: Joanne M. Goodfellow

Graphic Designers: Nancy J. Hajeski, Mary Van Bodegon

Illustrator: Alice Topf-Cirica

Editorial Secretaries: Mary James,

Ruth Ottenheimer, Audrey Naumburg

Editorial Administrator: Camille Metzler

Editorial Offices:

Headquarters: 10 Mulholland Dr., Hasbrouck Heights, N.J. 07604 (201) 393-6000, TWX-710-990-5071 (HAYDENPUB HBHT), Cable Haydenpubs. **Boston:** Hillcrest Office Park, 260 Bear Hill Rd., Suite 100, Waltham, Mass. 02154, (617) 890-8050. **Sunnyvale:** 1307 South Mary Ave., Suite 212, Sunnyvale, Calif. 94087, (408) 736-6667. **Los Angeles:** 8939 South Sepulveda Blvd., Suite 260, Los Angeles, Calif. 90045, (213) 641-6544. **Chicago:** 200 East Ontario, Chicago, Ill. 60611, (312) 337-0588. **Dallas:** 9451 LBJ Freeway, Suite 220, Dallas, Texas 75243, (214) 234-0508. **England:** Avalon House, Cranston Road, East Grinstead, West Sussex RH19 3HG, 0342-314111.

National Sales Manager: Paul C. Mazzacano

Director of Marketing: Stephen E. Scrupski

Assistant: Betsy Tapp

Business Manager: Thomas E. Vachon

Promotion Manager: Jay McSherry

Assistant: Evelyn Schmidt

Copy Writer: James Keane

Research Manager: Kenneth J. Turtoro

Advertising Production Manager: Marjorie Duffy

Assistants: Roseanne Erickson, Evelyn Porta

Circulation Director: Barbara Freundlich

Fulfillment Manager: Lori Shulman

Reader Service: Paula Greenleaf

Reprints: Jim Dysert

Vice President and Publisher:

Laurence Altman

BEHIND THE COVER

Creating one of the first processor chips to depart completely from the traditional von Neumann architecture is a heady undertaking. For a company involved in commercial microelectronics for only three years, it might seem brash, but that didn't faze NCR.

"I'm not sure that the management believed in the systolic array processor all that much," recalls Paul Sullivan, "but they let us go ahead." Indeed, he admits to having no more than a passing interest in systolic arrays when the engineers at Martin Marietta brought up the concept in a 1982 meeting.

But Sullivan, the head of advanced development at NCR's Microelectronics Division, was soon convinced of the array's importance, and his enthusiasm proved contagious. The result—an architecture that links a number of processors handling data quickly in parallel—is the topic of this issue's cover story (p. 207).

Less than a year after the project got under way, first silicon rolled off the line. Although the initial array of 3 by 6 processors came in at a staggering 200,000 mils² (the fabrication personnel thought it ridiculous to continue), it proved that the design was sound. Further, it furnished a breadboard to help assemble the final instruction set.

Cutting the chip down to size—by half—while quadrupling the number of processors was no easy task. In fact, the 6-by-12-processor array was the first NCR part to incorporate a second layer of metallization, as well as the densest CMOS device the company ever ran through fabrication. "I'm still not sure that tackling both these firsts simultaneously was a good idea," confesses Sullivan.

Finding suitable CAD tools for such a complex chip was a problem in itself, particularly because of the difficulty in checking design rules at the densities involved. Also, the amount of information that made up the design data base was so massive that most machines employed in fabricating masks simply couldn't accept it.

In a project this ambitious, teamwork was essential. At the start, though, senior circuit designer Dave Thomas was about the only individual assigned full-time to the processor. He did stay in close contact with Martin Marietta's Wlodzimierz Holsztynski—the mathematician responsible for the architecture of the processor elements.

DEPARTMENTS

- 3 Behind the Cover
- 6 Contents Spotlight
- 11 On Reflection
- 15 Reader Feedback
- 27 U.S. Meetings
- 31 Personally Speaking
- 111 International Meetings
- 504 Index of Advertisers
- 506 Reader Service Card

1984 CAREER SURVEY

137 Despite high salary levels, engineers are not wholly satisfied

Nearly half our readers have at one time or another considered changing their profession. Yet despite their grumblings, most exhibit remarkable loyalty toward their employer.

PERSONAL COMPUTER SERIES

163 Introduction

166 Personal instrument system blends the two worlds of testing and measuring

Drawing on an IBM PC, a modular instrument system builds a base for acquiring data at rates topping 200 kbytes/s.

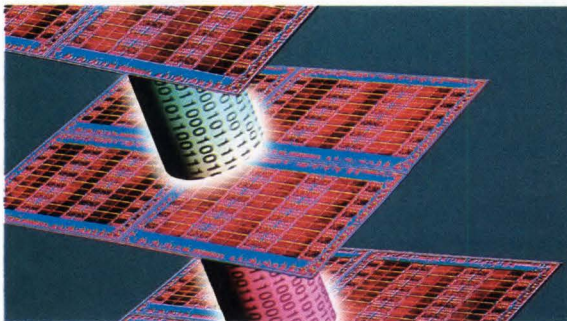
180 Software lets PC control instruments with a touch

A library of assembly-language routines turns the HP 150 personal computer into a touch-sensitive IEEE-488 controller.

DESIGN ENTRIES

207 Cover: Systolic array chip matches the pace of high-speed processing

A monolithic systolic array packs 72 single-bit parallel processors, letting it clip along at rates demanded to process images in real time.



TECHNOLOGY NEWS

35 Newpulse Newsfront

- 45 Smart interface standard anticipates needs of future minicomputers
- 46 Oxide-isolated process yields radiation-hardened arrays
- 48 Capless connector keeps a lid on cost, not on flexibility
- 52 Superminis adopt Unix variation, with no performance loss
- Conference Preview**
- 59 High efficiency will be the target at first photovoltaic conference
- 65 Wescon '84 gives the nod to DSP and data-comm ICs and to surface mounting

News Analysis

- 73 Emulators shift to production and field testing
- Viewpoint**
- 83 To think for themselves, computers must first learn some common sense
- 84 Bridging the gap between hosts is the key to unlocking communications software
- 97 **International Newsfront**
- International News Analysis**
- 99 On the European front, compilers focus on design
- 123 **Electronica Product Highlights**

227 12-bit a-d converter slips smoothly into analog and digital realms

Running from just 5 V, a 12-bit analog-to-digital chip lowers system parts count with direct analog and microprocessor interfaces.

247 Digital oscilloscope is quick on the trigger to nab elusive glitches

The triggering system for a 1-GHz digital-signal scope breaks radically with tradition but brings an element of certainty to an uncertain domain.

263 SCSI chip simplifies host-peripherals interface for microcomputer use

The first dedicated chip capable of driving the SCSI bus directly can serve as either an initiator or a target and supports device disconnection and reconnection.

287 Dynamic RAM controller weds reduced chip count and quick access time

Its internal delay line and advanced arbitration scheme let a monolithic controller keep support circuitry at a minimum and memory access speed at a maximum.

319 Design Solutions:

Simple program calculates component values for phase-locked loop. Low-cost phone chip makes swept-frequency special-effects sounds. Bus adapter connects two-wire peripherals to three-wire VMEbus.

PRODUCT REPORT

337 Focus on monolithic precision op amps

Lower input offset voltage and temperature drift, higher speed and quicker settling time, and increased open-loop voltage gain are among the traits of the latest precision op amp chips.

NEW PRODUCTS

355 Comdex/Fall '84 Highlights

356 8-in. Winchester drive hits 660 Mbytes, accesses in 18 ns

358 SCSI controller cards boost capacity, manage removable disks and tapes

Analog

373 Single chip develops all the trig functions from sine to arctangent

Power

382 Compact switching supplies fit inside Winchester and floppy-disk drives

Computer Boards

419 Multibus computer board transfers 32-bit blocks

Digital

427 Fast CMOS FIFO registers are the deepest yet

Computer Systems

437 CAE workstation works at 2 MIPS

Computer Peripherals

447 Low-cost unit recognizes 100 continuous words

400 Communications

453 Instruments

456 Components

461 Factory Automation

466 Software

474 Product News

479 New Literature

IN THE NEXT ISSUE

CAE Technology: The first of two reports exploring how CAE systems and tools build application-specific ICs ... A comprehensive package of CAE-related articles featuring advances in silicon compilation, testing languages, and full life-cycle design ... Potential uses of a systolic array chip.

Cover photograph by Bill Longcore
138,609 copies of this issue printed

ELECTRONIC DESIGN (USPS 172-080; ISSN 0013-4872) is published biweekly with one additional issue in February, May, October and December and two additional issues in August by Hayden Publishing Company, Inc., 10 Mulholland Dr., Hasbrouck Heights, N.J. 07604. Subscription rates are \$45 per year U.S. (foreign rates available upon request). James S. Mulholland Jr., President. Printed at Brown Printing Co., Waseca, Minn., Somerset Publishing Co., Somerset, N.J., and Wisconsin Cuneo Press, Milwaukee, Wis. Second-class postage paid at Hackensack, N.J. 07602 and at additional mailing offices. Copyright © 1984, Hayden Publishing Company, Inc. All rights reserved. POSTMASTER: Please send change of address to ELECTRONIC DESIGN, PO BOX 1418, Riverton, N.J. 08077.

POWER OP AMPS

HIGH
CURRENT
HIGH VOLTAGE



±40V @ 5A



±40V @ 10A



±145V @ 40mA

UNSURPASSED
RELIABILITY

DRIVE:

MOTORS • COILS
ACTUATORS • X-DUCERS

11 OTHER MODELS

SCREENED TO:
MIL-STD 883 METHOD 5008

SEE GOLDBOOK FOR:
PRODUCT SPECIFICATIONS
SALES REPRESENTATIVES

APEX MICROTECHNOLOGY CORP.
1130 E. Pennsylvania, Tucson, AZ 85714
ORDERS AND INQUIRIES: (602) 746-0849
APPLICATIONS HOTLINE: (800) 421-1865
CIRCLE 5

APEX
μtech

IN PURSUIT OF EXCELLENCE

CONTENTS SPOTLIGHT

1984 Career Survey 137

Though today's engineers and engineering managers generally earn comfortable salaries and get annual raises, ELECTRONIC DESIGN'S 1984 Career Survey reveals that many are not completely pleased with their profession or their jobs. Nevertheless, when their employer calls them to duty, the majority will sacrifice their personal time—including their vacations. Other engineers no longer merely dream of owning a business; they actually have plunged into entrepreneurship. The results of the survey will no doubt surprise ELECTRONIC DESIGN readers and also give them an inside look at their colleagues.

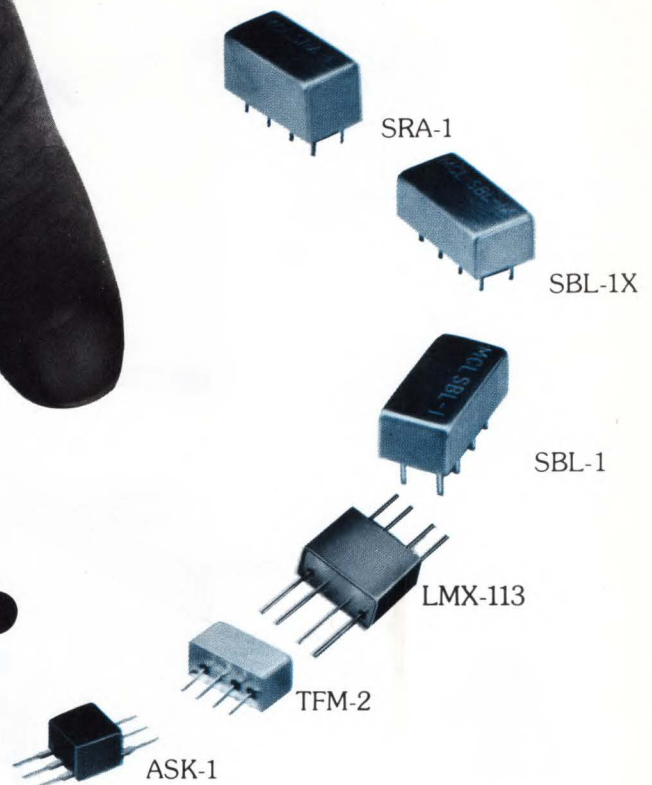
Personal Computer Series 163

Although not initially greeted with open arms, the union between personal computers and testing and measurement instruments may be the proverbial match made in heaven. Its offspring—the personal instrument—has made its mark on almost every aspect of our industry. In this issue our ongoing series scrutinizes how such instruments have affected data acquisition. The first entry documents a complex data acquisition and analysis system that is built around the IBM PC personal computer (p. 166). The second focuses on a software package that gives the HP 150 personal computer the ability to control IEEE-488 instruments through its touch-sensitive screen (p. 180). That makes it the only instrument system that can be directed with merely one finger.

Cover: Systolic array chip 207

Sidestepping the traditional von Neumann architecture, a single chip squeezes aboard 72 single-bit parallel processors, giving it the ability to breeze through high-speed chores. The processor chip can also be stacked in blocks, so that it even takes on real-time image processing without the slightest pause.

pick a mixer



500 KHz to 1 GHz from \$3⁹⁵
hi-rel and industrial
miniature, flatpack, and low profile

MODEL	FEATURES	Freq. (MHz)		†Conversion Loss (dB)		L-R Isolation (dB)			Price/Qty.
		LO-RF	IF	one octave bandedge	total range	lower bandedge	mid range	upper bandedge	
SRA-1*	the world's standard . . . HTRB tested hi-rel 3 year guarantee	.5-500	DC-500	5.5 typ.	6.5 typ.	50 typ.	45 typ.	35 typ.	11.95 (1-49)
TFM-2*	world's tiniest hi-rel mixer only 4 pins for plug-in/flatpack mounting,	1-1000	DC-1000	6.0 typ.	7.0 typ.	50 typ.	40 typ.	30 typ.	11.95 (6-49)
SBL-1	world's lowest cost industrial mixer, only \$4.50, metal case	1-500	DC-500	5.5 typ.	6.5 typ.	50 typ.	45 typ.	35 typ.	3.95 (100) 4.50 (10-49)
SBL-1X	industrial grade, rugged all-metal construction	10-1000	5-500	6.0 typ.	7.0 typ.	50 typ.	40 typ.	30 typ.	11.95 (1-9)
ASK-1	world's smallest DBM flatpack mounting, plastic case	1-600	DC-600	5.5 typ.	6.0 typ.	50 typ.	35 typ.	30 typ.	5.95 (10-49)
LMX-113*	rugged flatpack, hermeticity tested thermal shocked to MIL-STD-202	5-1000	DC-1000	6.5 typ.	7.0 typ.	50 typ.	40 typ.	35 typ.	14.95 (6-24)

*meets MIL-M-28837/1A performance
units are not QPL listed

†LO = +7 dBm



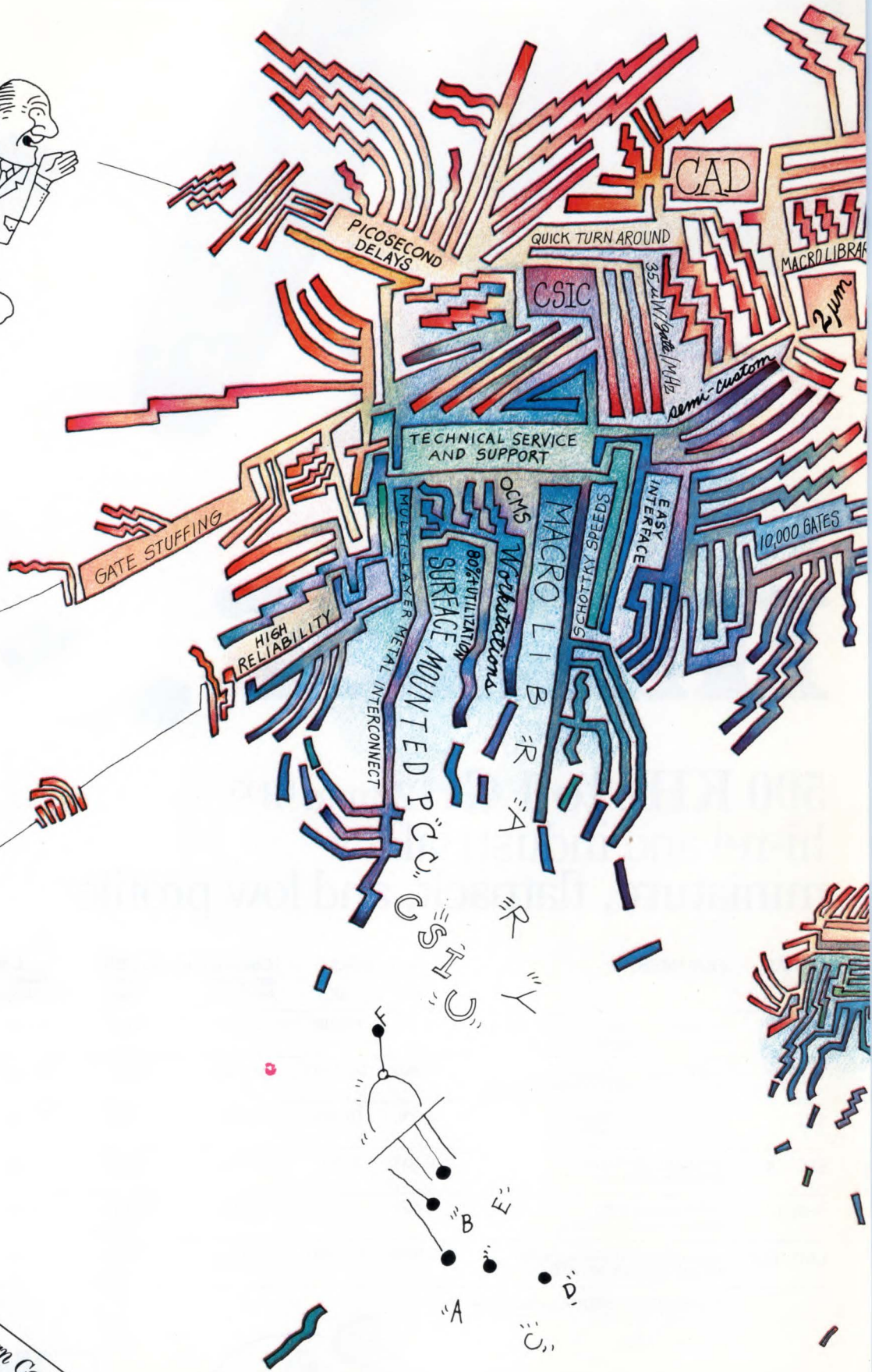
CIRCLE 6

finding new ways . . .
setting higher standards

Mini-Circuits

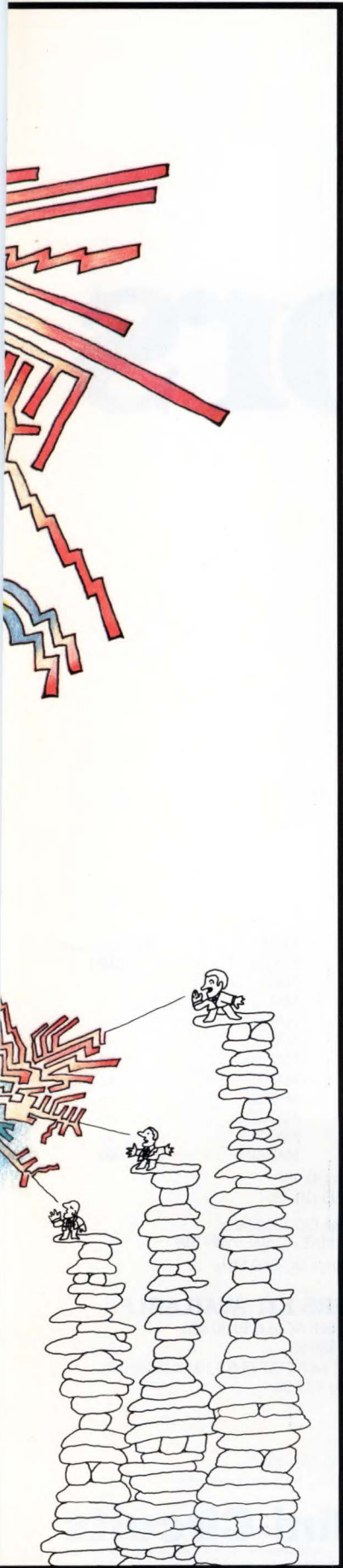
A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
P.O. Box 166, Brooklyn, New York 11235 (718) 934-4500
Domestic and International Telex 125460 International Telex 62015

C74 REV. F



See our microCMOS Gate Arrays Design Center at Wescon,
October 30-November 2, Booth #3690.

SALVATORE



Everybody talks CMOS gate arrays.

But only National goes
beyond talk to bring you low power,
one nanosecond gate arrays in
production quantities.

You know how it is.

Everybody's *heard* about the benefits of CMOS: High density gate arrays with Schottky speeds. Low CMOS power levels with latch-up immunity and ESD protection. All in production quantities.

"Great idea" they say.
"But it can't be done."
Obviously they haven't talked to National. Because we're doing it!

Using our proven micro-CMOS process technology, we've produced the SCX-Series of high-speed/low-power dual-layer metal gate arrays. Look at the benefits: National's SCX-Series offers a full family of gate array solutions. Including both $3\text{ }\mu\text{m}/2\text{ ns}$ arrays and the first $2\text{ }\mu\text{m}/1\text{ ns}$ internal tpd CMOS gate array in

production. Ranging from 600 to 6000 gates, they all drive 50 pF loads.

And we don't stop there.

National offers a fully integrated CAD system. With comprehensive training and logic simulation. Plus fault grading for design checking and testing. And 100% auto-place and route capabilities.

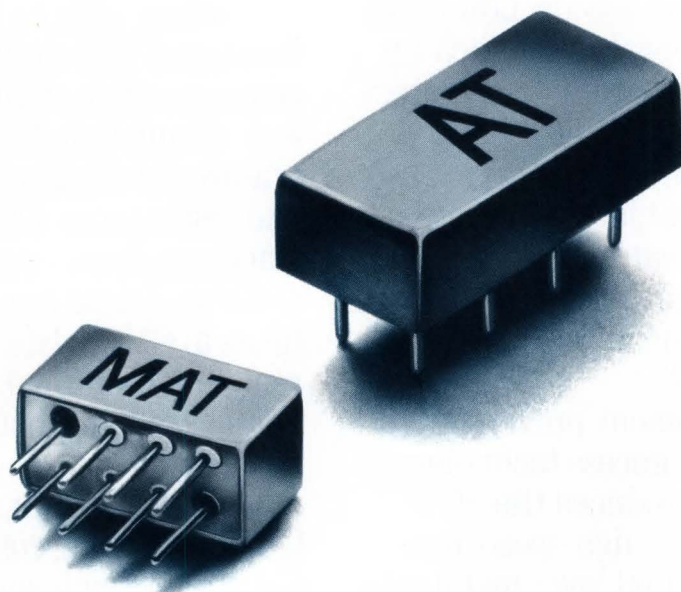
So next time the talk turns to CMOS gate arrays, remember National. We're not just talking about it. We're doing it.

For a copy of our micro-CMOS brochure, contact us at 2900 Semiconductor Drive, MS 23200, Santa Clara, California 95051.



**National
Semiconductor**
We're doing it.

gain from attenuators ?



YES Gain system reliability and improved performance using Mini-Circuits' low-cost, DC to 1500 MHz attenuators. Minimize interaction between subsystems (for example, mixer and amplifier) and eliminate spurious signals and oscillation by proper input/output matching. And only \$1.95 (AT-Series, 1000 qty.)

Choose from over a dozen models (1 to 40 dB) in the compact AT-Series (0.8 X 0.21 X 0.2 in.) or tiny MAT-Series (0.5 X 0.21 X 0.25 in.) housed in a rugged, hermetically-sealed metal case meeting MIL-STD-202. VSWR is less than 1.2:1 (typ.), frequency response is flat ± 0.3 dB (typ.), and nominal attenuation is within ± 0.3 dB (typ.). Exceptional repeatability is achieved by laser trimming internal resistors.

No waiting, immediate delivery. One-year guarantee. Call or write for 64-page catalog or see our catalog in the Gold Book, EBG, EEM or Microwave Directory.

AT Series	MAT Series	Attenuation (dB)
AT-1	MAT-1	1
AT-3	MAT-3	3
AT-6	MAT-6	6
—	MAT-9	9
AT-10	MAT-10	10
—	MAT-12	12
—	MAT-15	15
AT-20	MAT-20	20
AT-30	MAT-30	30
AT-40*	MAT-40*	40

AT Series \$3.95 (10-49)

MAT Series \$4.95 (10-49)

Frequency Range DC-1500 MHz
power (max.) MAT = 0.5W, AT = 1W

*Frequency Range DC-500 MHz

DESIGNERS KIT AVAILABLE:

KAT-1 . . . 4 of each AT (3,6,10,20 dB),
only \$39.95

KMAT-1 . . . 2 of each MAT (3,6,9,10,12,15,20 dB),
only \$39.95

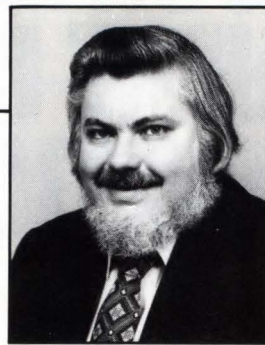
finding new ways . . .
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
P.O. Box 166, Brooklyn, New York 11235 (718) 934-4500
Domestic and International Telex 125460 International Telex 620156

ON REFLECTION

User convenience should govern decisions in instrument design



In the test and measurement world, the user interface determines whether an instrument will be considered easy to operate or not much fun to work with. Regardless of how well that instrument actually performs, a poor interface could dramatically impair a product's acceptance.

Instrument engineers are constantly making decisions on how a user will interact with complex equipment. But right now, the design of that interface is more art than science. Many designs are driven not by what is best for the user but rather by what is easiest for the instrument engineer—a condition exacerbated by the influence of the personal computer.

Basically two categories of user interfaces have emerged. In the first, a sophisticated instrument has a computer inside it, and the user interacts with it through a dedicated front panel equipped with a display and easily identified control knobs and switches. Each instrument retains a separate identity that human beings can relate to.

In the other category are instruments that are either controlled through a computer terminal or actually incorporated within a personal computer. Here the user is dealing with a computer, not an instrument.

Instrument engineers are not alone in trying to centralize the control of operations in a computer, but that may not be the optimum choice for all cases. Are there not times, for instance, when it is really easier and faster to reach for a pocket calculator after writing a check than to boot up a personal computer to figure the balance? Similarly, reaching directly for a frequency counter is often more efficient than firing up a computer.

There is no question that controlling some

instrument functions with a computer makes a lot of sense. Data acquisition and analysis systems are naturals: Once a test begins, little user interaction is needed. The system automatically acquires data, analyzes it, and displays the results in the desired format.

In contrast, consider a designer who is using a digital oscilloscope for debugging a circuit. He or she frequently changes control settings, moves probes, and consults the display—a process better served by a dedicated instrument. Changing scope settings with a computer terminal forces the designer to translate the desired actions into keyboard instructions. In other words, the designer has to accommodate the computer.

Clearly, a peaceful coexistence is the best solution. In that respect IEEE-488 instruments stand out, as they can be operated manually or controlled by a computer. Dedicated instruments will always find a place, just as there will always be a need to add test and measurement functions to an engineering workstation. The challenge is deciding which instruments should remain dedicated.

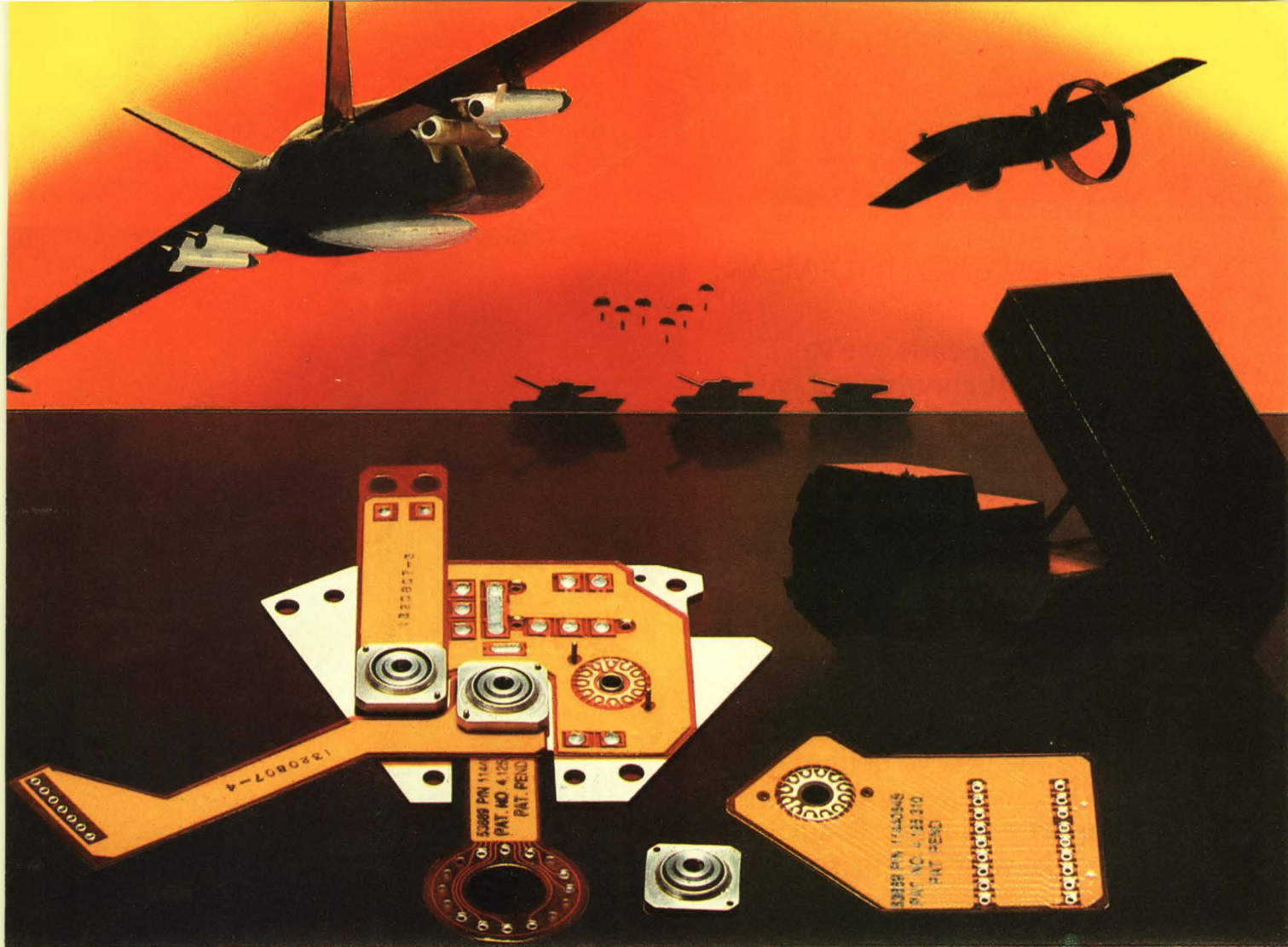
How well tomorrow's instruments serve the user will be determined by the instrument engineers. Their expertise should be more than technical; it should be complemented by human considerations, so that computers and instruments ultimately adapt to the needs of people, not the other way around.

Robert M. Milne III

Robert M. Milne III

**256K DRAMS IN CHMOS.
THERE HAVE BEEN OTHER
INNOVATIONS AS IMPORTANT.**





Gold Dot Interconnection System: When Connectors Can't Cut It.

They've thrown you a curve. Your interconnection application calls for reliability and/or density requirements that are out of sight. To top it off, there's no room for a connector, which would be too heavy anyhow.

But hold on. Maybe there's a way. Instead of connectors, consider a custom designed Gold Dot Interconnection System. All the applications shown are exceptionally demanding but Gold Dot handles them.

What it is. Gold "bumps" are deposited on flexible printed circuits using a patented process. A simple clamping mechanism containing a spring member and a screw for pressure and a polarizing pin for alignment assure positive, efficient mating. Simple. Effective. Better.

How it's better. Higher reliability, with thousands of mating cycles and no pin/socket contacts or solder joints. Density down to 15 mil centers. Saves space and weight, with no connector bodies or cumbersome couplings. High forces break through

surface oxides. Zero-force mating, gas-tight joints. Better RFI/EMI protection, shock resistance, durability. Installed cost may be lower than with conventional systems.

Some applications. Missile launch/guidance, detector systems, remotely piloted vehicles, torpedo circuits, airspeed indicators, fire control systems, computers, etc.

The Gold Dot Interconnection System has proven itself superior to conventional systems. But will it replace the connector? Will Caddies replace Chevies?

More information? Phone Tony Piraino, 714-660-5788. Or write Hughes Aircraft Company, Connecting Devices Division, 17150 Von Karman Avenue, Irvine, CA 92714. In Europe, Hughes Microelectronics, Ltd., Clive House, 12-18 Queens Road, Weybridge, Surrey KT13 9XD, England.

HUGHES
AIRCRAFT COMPANY

11,000 GATES

NEVER HAS SO LITTLE MEANT SO MUCH.

In the last decade, we've opened more technological gates than anyone.

In both CMOS and bipolar.

Our 11,000 gate 2 micron CMOS array is just part of the story. We also offer TTL up to 2,000 gates. ECL to 3,000 gates. And 400 to 11,000 gate CMOS arrays. Not to mention our 100K- and 10KH-compatible ECL arrays.

Of course, a gate array is only as good as the people behind it. And at NEC, we have some of the best support engineers. Ready to help you take your design from start to finish.

With easy-to-use CAD tools. And sophisticated software capable of simulating up to 20,000 gates. All available at our 18 customer design centers, worldwide.

As for quality, we offer 100% burn-in, standard. At no extra cost. And you won't have to wait long to get it. Our turnaround is as quick as 8 weeks.

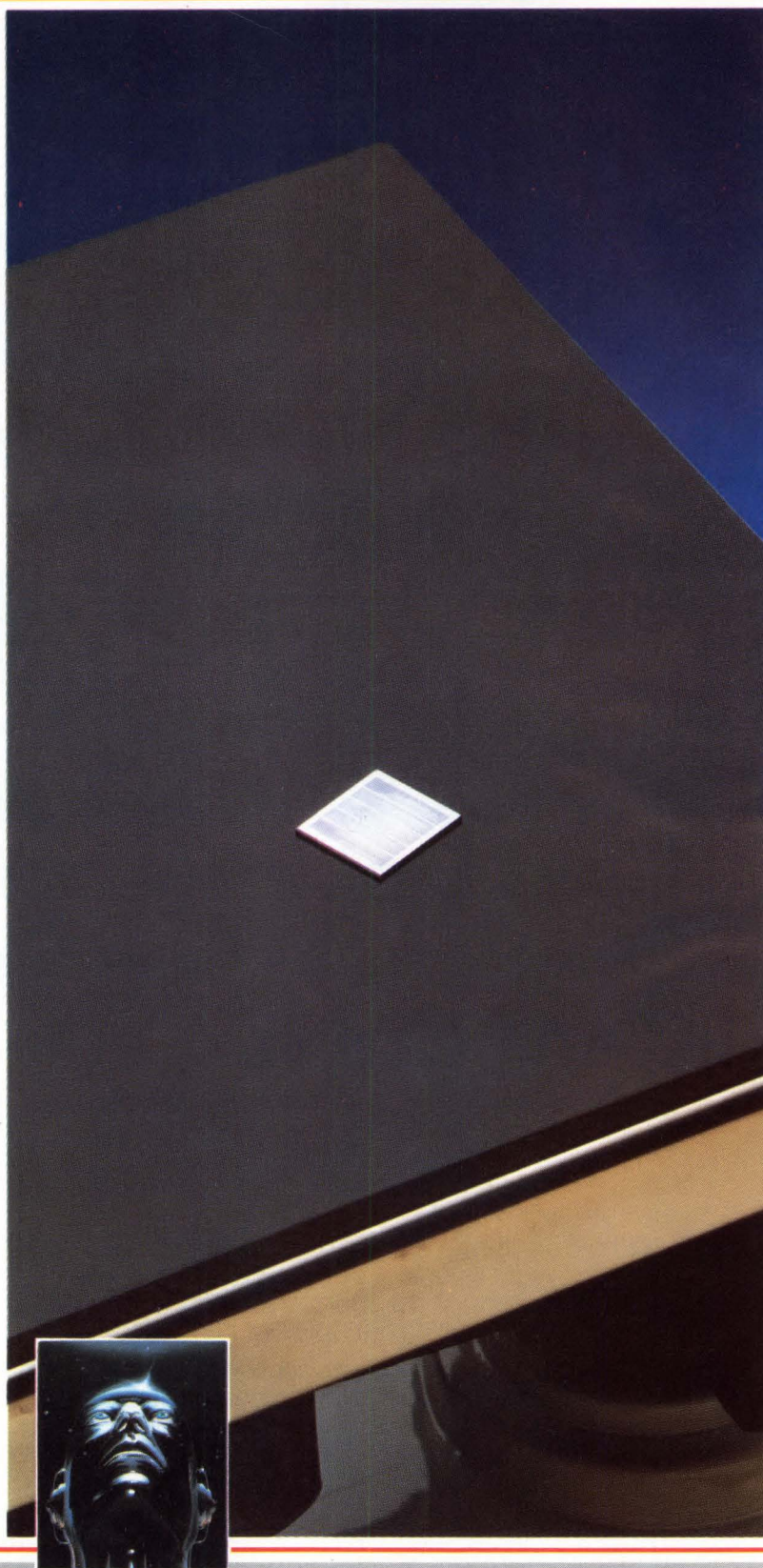
So next time you need a gate array, weigh your alternatives. Then call NEC.

WE'RE TAKING ON THE FUTURE.

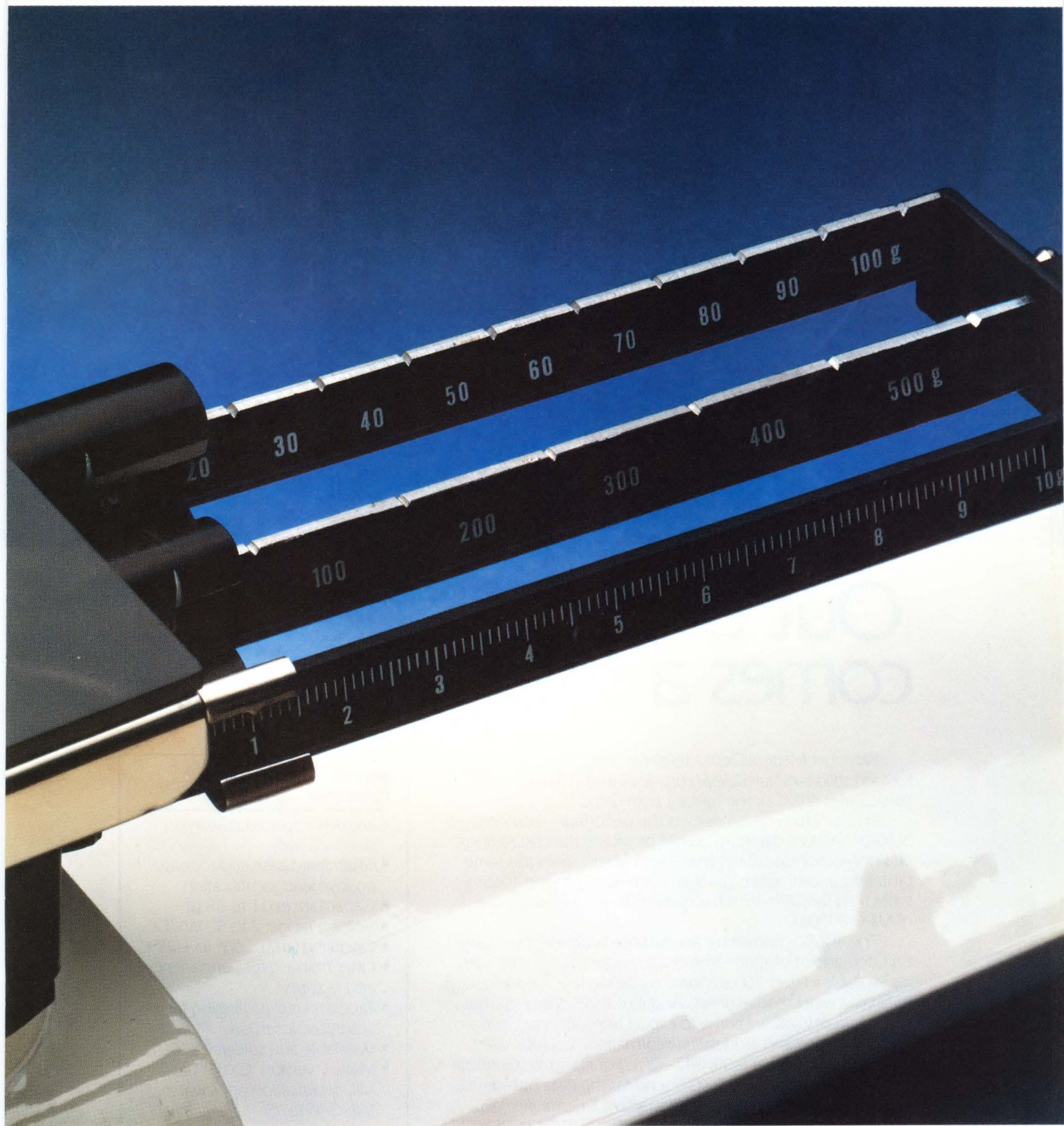
For the fastest response to your questions or for more detailed information, call us TOLL FREE at 1-800-556-1234, ext. 188. In California, call 1-800-441-2345, ext. 188.

NEC national sales offices: Woburn, MA (617) 935-6339 • Melville, NY (516) 423-2500 • Poughkeepsie, NY (914) 452-4747 • Ft. Lauderdale, FL (305) 776-0682 • Norcross, GA (404) 447-4409 • Columbia, MD (301) 730-8600 • Arlington Heights, IL (312) 577-9090 • Southfield, MI (313) 559-4242 • Bloomington, MN (612) 854-4443 • Austin, TX (512) 346-9280 • Dallas, TX (214) 931-0641 • Orange, CA (714) 937-5244 • Cupertino, CA (408) 446-0650

© 1984, NEC Electronics Inc.



PER GRAM.



NEC
NEC Electronics



COST EFFECTIVE • HIGH PERFORMANCE TANTALUM CAPACITORS

Out of our reliable mold comes a solid alternative.

Now get Mepco//Electra reliability in a whole new body! Molded solid tantalum capacitors, available in the industrial grade Series 40MS or the military style CX05.

This molded version delivers the performance advantages of solid tantalum capacitors while providing the cost savings of a non-metal case. The new 40MS series utilizes the same tantalum anode and is processed identically to the 40SS series solid tantalum which is qualified to the S reliability level of Mil-C-39003/01.

The 40MS is perfect for applications where a metal case isn't demanded or space limitations require smaller case sizes. It's available in over 300 standard capacitance - voltage ratings to fit your exact requirements. And it provides the outstanding level of quality you've come to expect from Mepco//Electra.

Need price and availability information? Call our West Palm Beach facility at (305) 842-3201. For complete technical details on the 40MS and CX05, send for the data bulletins. Mepco//Electra, Corporate Headquarters, Columbia Road, Morristown, NJ 07960. (201) 539-2000. TWX: 710/986/7437.

Molded Solid Tantalum Capacitor - Series 40MS

- Molded insulated case in 6 standard sizes
- Chamfered case end for easy positive lead identification
- Capacitance: 0.1 to 68 μ f
- Voltage range: 2 to 50 WVDC
- Operating temp.: -55° to +125°C
- Laser marking for permanency and legibility
- Tape and reel packaging for automatic insertion
- Weldable and solderable leads
- Military version (CX05) has MIL qualification approval to MIL-C-49137/5

CIRCLE 51

Reliability across the board™
Mepco//Electra
A NORTH AMERICAN PHILIPS COMPANY

READER FEEDBACK

Don't count out custom power supplies

Our company has been in business for the past 24 years. For most of that time, we have been making custom power supplies, and we take issue with a letter from Warren C. Ives, marketing manager of AC/DC Electronics of Oceanside, Calif., under the headline "Catalog Power Supplies Are a Sure Bet" [Aug. 23, p. 15].

Item 1 of the letter states that custom power supplies cost much more in development costs, lead time, and contract quantities. Undoubtedly that is true, and one should always look for an off-the-shelf product. However, off-the-shelf power supplies have been designed for one thing, to fit the broadest range of applications at minimum cost, and they therefore require the taking of short-cuts. Custom power supplies, on the other hand, are specifically tailored to a user's requirements.

Custom supplies do require extensive and detailed specifications, as Mr. Ives states. However, that means that all concerned get what they want: The buyer achieves his system design goals, and the custom power supply manufacturer knows what is expected.

The second point of Mr. Ives's letter is that many "reputable" power supply manufacturers will not consider custom designs unless

the potential volume is quite large. We would like to point out that our many customers consider us to be a reputable manufacturer, and we certainly believe in custom power supply designs. What's more, we have many satisfied customers who return time after time. We would also like to point out that there must be something to the fact the custom power supply market is growing rather than shrinking.

In his third point, Mr. Ives says that custom designs are new products without known field reliability. It is true that custom designs do not have field-proven experience. Nevertheless, fewer than 2% of all power supplies we have shipped necessitated return for failure. Compare that with any other reputable power supply company having off-the-shelf designs.

I would agree with Mr. Ives's fourth point, that custom power supplies often come from one source and most new power supply companies do custom work but are often underfinanced. There are, however, several companies in the custom power supply business that are suppliers of both military and industrial units. They are both reputable and well financed, and they do a good job.

The length of time, the access to a vendor, and the process of locating a custom power supply company to accomplish a particular requirement are not the prob-

A pushbutton instead of a fuse.

Re-Cirk-It® resettable circuit protectors replace glass fuses in a variety of product applications—stereo components, computer terminals, oscilloscopes, medical equipment.

In ratings from 0.25 A to 15 A at 250 Vac or 32 Vdc, and up to 10 A at 50 Vdc, Re-Cirk-It slips into the same space as a standard 5/8" fuseholder. And trips only on sustained overloads or short circuits.

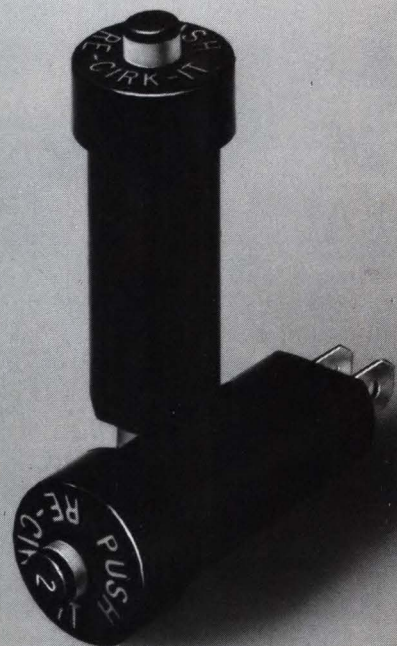
But the best part is—it's pushbutton-resettable. Your customer will suffer no more hasty searches for replacements. And you'll receive no more service calls for a blown fuse.

UL-recognized; CSA-certified; SEV-approved. Call or write for Bulletin KD-4001.

HEINEMANN® ELECTRIC COMPANY

P.O. Box 6800, Lawrenceville, NJ 08648-0800 USA
(609) 882-4800 • Telex 843431

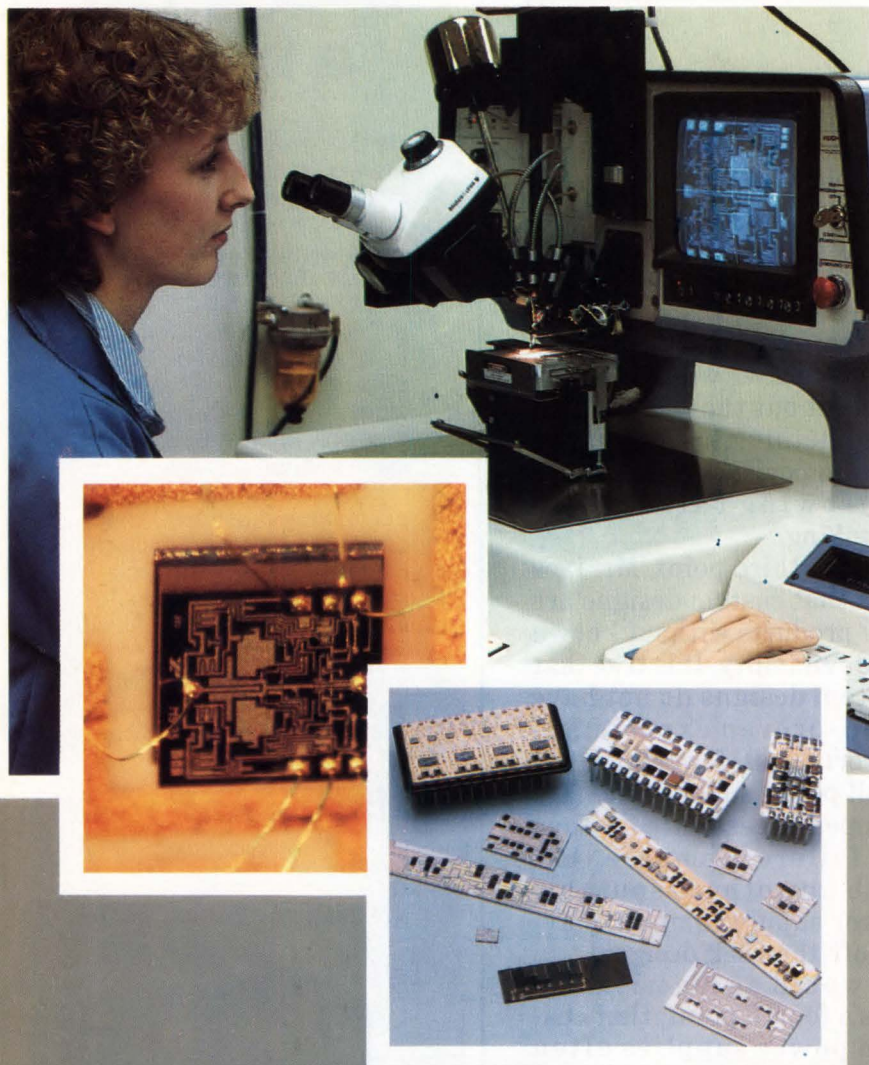
We keep you out of trouble.



© Copyright 1984, Heinemann Electric Company

7992

Your CUSTOM HYBRID Source



Put your hybrid circuit needs in the hands of an industry pioneer. HEI has been in the hybrid circuit manufacturing business for over 15 years, and offers the latest in processing capabilities and staff talent to meet your requirements.

HEI specializes in production of custom design-disclosed, high density active hybrid circuits for all kinds of electronic applications. Capabilities include automated ceramic sawing, computer-controlled laser trimming of circuits under load, automatic wire bonding and computerized circuit testing.

HEI offers two-week turn-around on quotes, and just seven weeks for prototypes. Call the Hybrid Hotline—612-443-2500 for clear answers to your custom hybrid circuit manufacturing questions.

 **HEI inc.**

Victoria, MN 55386 • 612-443-2500

READER FEEDBACK

lems. The problem is that power supplies are the least understood part of the system, are often left to the last, and therefore represent the "tail wagging the dog" as far as the system delivery is concerned.

Reputable companies in the custom power supply business provide a valuable service to users that augments the services performed by the "big brothers" in the off-the-shelf marketplace. Do not count us out!

Jerry Satuloff

Director of

Marketing/Sales

CEA

Division of Berkleonics Inc.
San Luis Obispo, Calif.

Electronic Design welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to Editor, Electronic Design, 10 Mulholland Dr., Hasbrouck Heights, N.J. 07604. Try to keep letters under 200 words. Letters must be signed. Names will be withheld upon request.

ELECTRONIC DESIGN is growing.

If you'd like to grow with us, you may be interested in one of the editorial opportunities we have in our New York area home office or in our field offices in the United States, Europe, and Japan.

We are interested in people with experience in all aspects of electronics, especially the explosive area of computer technology. To explore your potential in the exciting world of engineering journalism, send your résumé to Lucinda Mattera, Editor-in-chief, Electronic Design, 10 Mulholland Drive, Hasbrouck Heights, N.J. 07604.



Run INTEL software and full-screen symbolic debugger on your IBM-PC

- Get our complete development solution: compilers, assembler, linker, debuggers, and emulators for the entire 8086 family: 8086, 8087, 8088, 80186, . . .
- Run under MS-DOS with our GenePak®-PLM package, containing Intel's PLM86, ASM86, LINK86, LOC86, LIB86, and OH86. Options include PASCAL86, FORTRAN86, and C86. Or use the Intel software you already own.
- It takes less than 6 minutes to recompile a 1000-line PLM86 module and relink it with 34 others to regenerate a 40K program.
- Use GeneScope®, our interactive, fully symbolic debugger and emulator line. It features macros, help, on-line assembly, automatic disassembly and trace with scrolling, simultaneously supporting separate screens for debug and source-file viewing during one debug session. GeneScope is easier to use and faster than PSCOPE, ICE-86, and I²ICE, loading 100K programs in under 15 seconds. Its powerful user interface runs in your PC, either connected to your target system with

GeneProbe®, our full in-circuit emulator, or as a software-only debugger for programs in your PC or your target system.

- Use our PC ↔ MDS datalink program to bring over your existing libraries or store back your new modules. It transfers files of any kind, in either direction.

Call us today.

CIRCLE 12



Genesis™
Microsystems

196 Castro Street, Mountain View, CA 94041 (415) 964-9001

Genesis is a licensed OEM of Intel Corp.

*are Trademarks of Intel Corp.

INTERNATIONAL DISTRIBUTORS • Instrumatic: **Deutschland**—München, Tel. 89/85 20 63 • **España**—Madrid, Tel. 1/250 25 77—Malaga, Tel. 5/221 38 98 • **Schweiz**—Rueschlikon, Tel. 1/724 14 10—Geneve, Tel. 022/36 08 30
• **United Kingdom**—High Wycombe, Tel. 494 450 336 • **Israel**—Savyon: Micro-Bit, Tel. 03-380098 • **Japan**—Tokyo: Asahi Business Consultant Co., Tel. (03) 543-3161; Showa System Laboratory, Tel. (03) 361-7131.

When reliability is imperative.™



Photo courtesy U.S. Dept. of Defense.

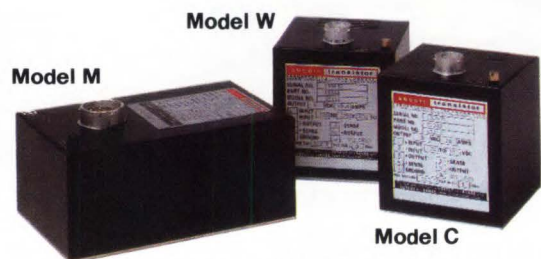
NEW! Enhanced Reliability for Standard Power Supplies.

No longer is it necessary to have a power supply custom designed to meet stringent reliability specifications. Abbott now offers the "ER" option for standard models to meet the extraordinary demands of the most critical military applications. Series M, C and W are now available with an even higher level of select components than our standard components, resulting in the impressive MTBF ratings shown in the table at right.

In addition, we can also incorporate any level of "ER" components you designate in the field-proven circuits of these standard models to meet your specific applications.

Find out how you can benefit from this new concept by contacting: Abbott Transistor Laboratories, Inc., Power Supply Div., Western Office: 5200 W. Jefferson Blvd., Los Angeles, CA 90016. (213) 936-8185. Eastern Office: 520 Main St., Fort Lee, NJ 07024. (201) 461-4411. Southwest Office: 710 Kindred Lane, Richardson, TX 75080. (214) 437-0697.

Send for Full Line Catalog. 1,338 Models.



ENHANCED RELIABILITY OPTION

MTBF per MIL-HDBK-217D at baseplate 50°C

Input-Output	Model	Ground Benign	Air Inhabited
400Hz to DC	W5D10	1,067,965 Hrs.	110,453 Hrs.
400Hz to DC	W5D20	542,367	56,726
400Hz to DC	WW15D2.0	772,577	86,052
DC to DC	C5D10	1,058,179	126,802
DC to DC	CC15D2.0	1,115,126	111,968
Naval Sheltered			
60Hz to DC	M50D-5	187,251	29,261 Hrs.
60Hz to DC	M100D-5	119,095	18,350

abbott
MILITARY POWER SUPPLIES

U.S. MEETINGS

International Telecommunication Energy Conference (Inteltec), Nov. 4-6. Hilton Hotel, New Orleans, La. R. R. Garreau, AT&T Technology Systems, PO Box 374, Union, N.J. 07083; (201) 851-3078.

Lasers in Graphics, Nov. 4-8. Hyatt Regency, New Orleans, La. Dunn Technology Inc., 749 E. Vista Way, Vista, Calif. 92083; (619) 758-9460.

The Second International Congress on Advances in Non-Impact Printing Technologies, Nov. 4-8. Stouffer's Concourse Hotel, Arlington, Va. Robert H. Wood, SPSE, 7003 Kilworth Lane, Springfield, Va. 22151.

Autotestcon '84, Nov. 5-7. Washington, D.C. Autotestcon, 1725 Jefferson Davis Highway, Suite 704, Arlington, Va. 22202.

Federal Office Automation Conference, Nov. 6-8. Washington Convention Center, Washington, D.C. Federal Office Automation Conference, PO Box 322, Wayland, Mass. 01788; (617) 358-5301.

Government Microcircuit Applications Conference (GOMAC '84), Nov. 6-8. Riviera Hotel, Las Vegas, Nev. John Bart, Rome Air Development Center/RB, Griffiss AFB, N.Y. 13441; (315) 330-3064.

Computer Software and Applications Conference (Compsac '84), Nov. 7-9. Americana Congress Hotel, Chicago, Ill. Miriam L. Holden, Compsac '84, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, Ill. 60439; (312) 972-5585.

International Conference on Computer-Aided Design (ICCAD '84), Nov. 12-15. Santa Clara, Calif. John Domiter, AT&T, Room 4K523, Holmdel, N.J. 07733; (201) 949-6675.

1984 International Congress on the Applications of Lasers and Electro-Optics (Icaleo), Nov. 12-15. Boston Marriott, Copley Place, Boston, Mass. The Laser Institute of America, 5151 Monroe St., Suite 118W, Toledo, Ohio 43623; (419) 882-8706.

Automation '84, Nov. 13-14. Stanford Holiday Inn, Palo Alto, Calif. Lori Savate, Semi, 625 Ellis St., Suite 212, Mountain View, Calif. 94043; (415) 964-5111.

Interface I, Nov. 13-15. Conrad Hilton Hotel, Chicago, Ill. Marie Curcio, American Production and Inventory Control Society, 500 W. Annandale Road, Falls Church, Va. 22046; (703) 237-8344.

Power Conversion Products Council International (PCPCI), Nov. 13-14. Sheraton International, O'Hare, Rosemont, Ill. Betsy Bevington, PCPCI, Box 637, Libertyville, Ill. 60048; (312) 362-3201.

Comdex/Fall, Nov. 14-18. Las Vegas, Nev. Peter Young, The Interface Group Inc., 300 First Ave., Needham, Mass. 02194; (617) 449-6600.

Fallcon '84, Nov. 14-15. Stouffer's Five Seasons Hotel, Cedar Rapids, Iowa. H. L. Jim Hanson, IEEE, Cedar Rapids Section, PO Box 451, Marion, Iowa 52302; (319) 395-3505.

Globecom '84, Nov. 26-29. Atlanta Hilton Hotel, Atlanta, Ga. John Freight, Globecom '84, Scientific-Atlanta Inc., PO Box 105600, Atlanta, Ga. 30348; (404) 441-4800.

30th Annual Conference on Magnetism and Magnetic Materials, Nov. 27-30. Town and Country Hotel, San Diego, Calif. Ms. Diane Suiters, Courtesy Associates, 655 15th St. NW, Washington, D.C. 20005; (202) 347-5900.

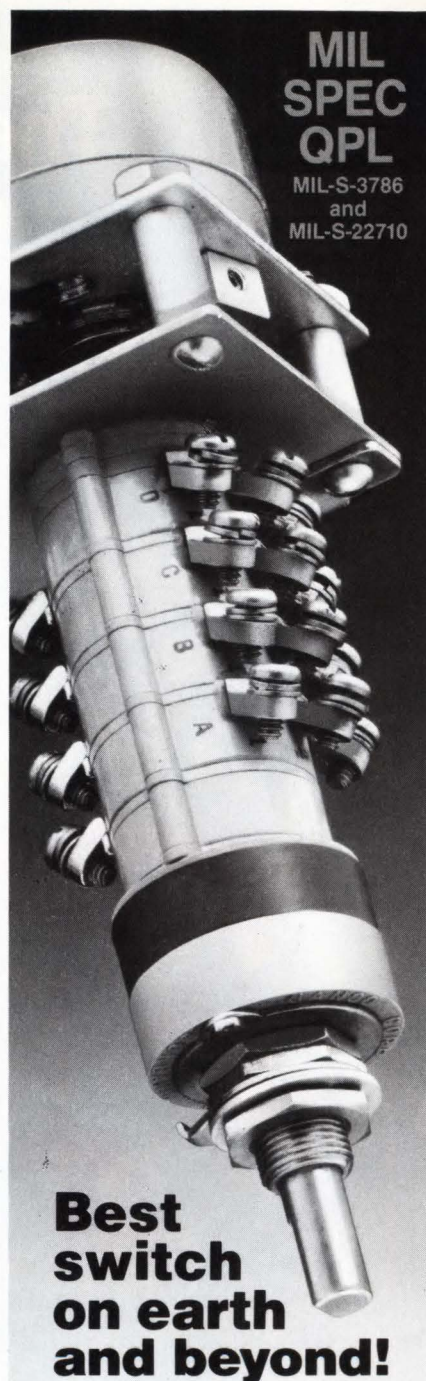
The Power Sources Conference, Nov. 27-29. Sheraton-Boston Hotel and Hynes Auditorium, Boston, Mass. The Power Sources Conference Inc., 3970 Atlantic Ave., Suite 204, Long Beach, Calif. 90807; (213) 414-4412.

Robots West, Nov. 27-30. Anaheim Convention Center, Anaheim, Calif. Robot Institute of America, PO Box 1366, Dearborn, Mich. 48121; (313) 271-7800.

Digital Avionics Systems Conference (6th DASC), Dec. 3-6. Baltimore Convention Center, Baltimore, Md. AIAA, 1633 Broadway, N.Y. 10019; (212) 581-4300.

Real-Time Systems Symposium, Dec. 4-6. Hyatt Regency Hotel, Austin, Texas. Mirosław Malek, Department of Electrical Engineering, University of Texas, Austin, Texas 78712; (512) 471-5704.

(continued on p. 29)



**MIL
SPEC
QPL**
MIL-S-3786
and
MIL-S-22710

Best switch on earth and beyond!

Shooting for the moon?

Our rotary switches have been there and back. And on almost every NASA project since the space program began.

We make everything from micro-miniature rotary selector switches to totally enclosed explosion-proof power selector switches, for major airframe and aerospace contractors all over the globe.

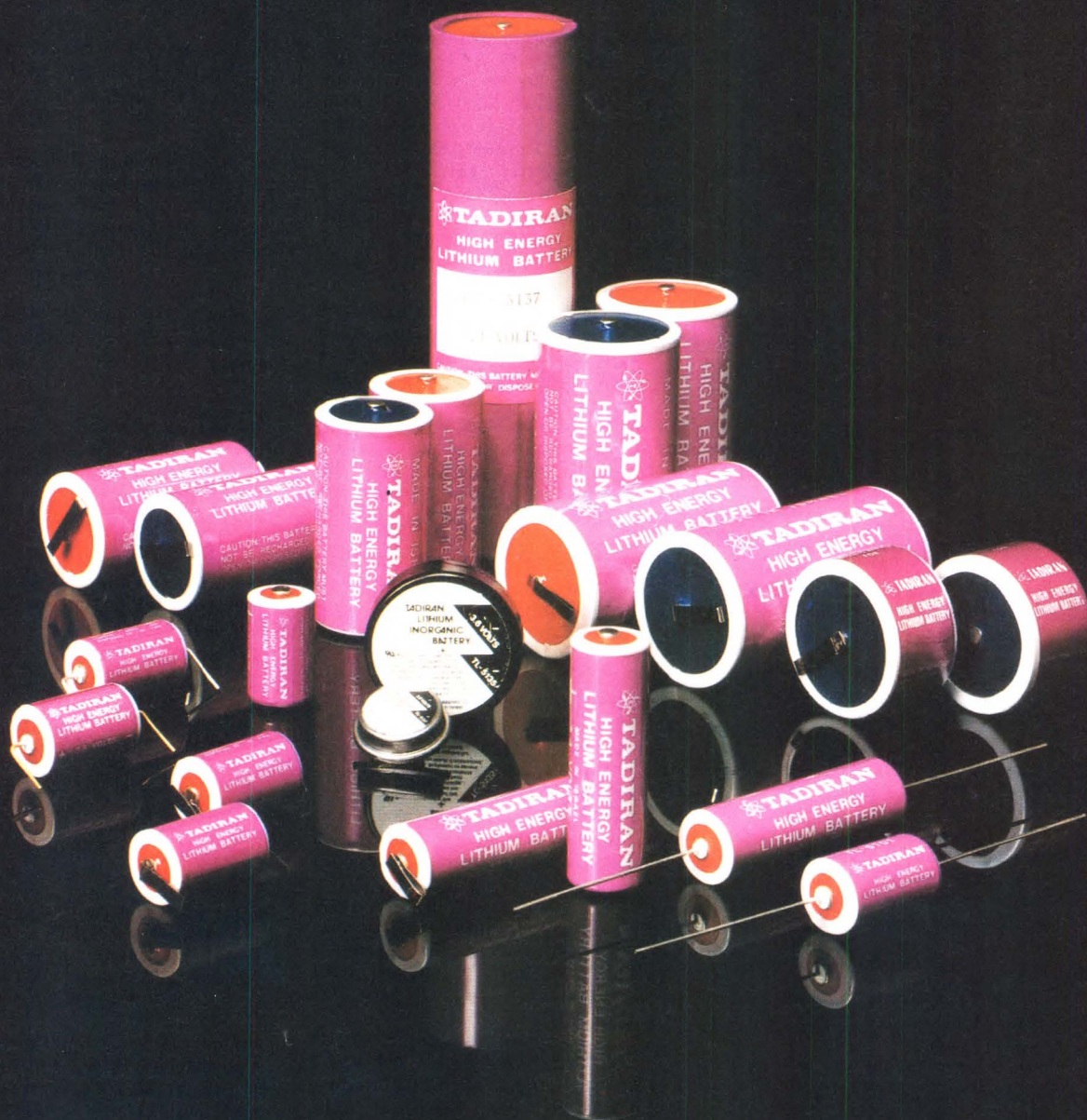
And, if we don't have what you need, we can design and custom build a switch to your exact specifications.

Even if they're out of this world.

Janco
An ESOP Corp.

P.O. Box 3038, 3111 Winona Avenue
Burbank, CA 91504 Phone (213) 846-1800
TWX 910-498-2701

The Component's Component



Concentrated energy supply for power back-up or continuous low drain power source in electronic applications.
CIRCLE 15

TADIRAN
Electronic Industries, Inc.

350 5th Ave. New York N.Y. 10118, U.S.A. Telephone: 212-947-4600
Lakeland Plaza Professional Bldg., Suite 263 Lewisville TX 75067, U.S.A.
Telephone: 214-221-7523

6312 Variel Ave. Suite 203, Woodland Hills, CA 91367, U.S.A.
Telephone: 213-884-3884. TLX W.U. 705384.

TADIRAN

11, Ben-Gurion Street, Givat-Shmuel, P.O.B. 648, Tel-Aviv 61006, Israel, Telex: 341692, Telephone: 03-713111

U.S. MEETINGS

(continued from p. 27)

Western Design Engineering Show, Dec. 4-6. Moscone Center, San Francisco, Calif. Western Design Engineering Show, 999 Summer St., Stamford, Conn. 06905; (203) 964-8287.

The First Conference on Artificial Intelligence Applications, Dec. 5-7. Sheraton, Denver Tech Center, Denver, Colo. Conference on Artificial Intelligence Applications, PO Box 639, Silver Spring, Md. 20901; (301) 389-8142.

1984 IEEE International Electron Devices Society (IEDM), Dec. 9-12. San Francisco Hilton and Towers, San Francisco, Calif. Melissa Widerkehr, Courtesy Associates Inc., 655 15th St. NW, Suite 300, Washington, D.C. 20005; (202) 347-5900.

Dexpo West '84, Dec. 11-14. Disneyland Hotel, Anaheim, Calif. Expoconsul International Inc., 55 Princeton-Hightstown Road, Princeton Junction, N.J. 08550; (609) 799-1661.

IEEE First International Conference on Office Automation, Dec. 17-19. New Orleans Hilton, New Orleans, La. IEEE First International Conference on Office Automation, c/o Dr. Donald Kraft, Department of Computer Science, Louisiana State University, Baton Rouge, La. 70803; (504) 388-1495.

1985 International Winter Consumer Electronics Show, Jan. 5-8. Las Vegas, Nev. Dennis Corcoran, CES, 2001 Eye St. NW, Washington, D.C. 20006; (202) 457-8700.

PC Fab Expo '85, Jan. 8-10. Sheraton Twin Towers Hotel, Orlando, Fla. Julia Wilson, PMS Industries, 1790 Hembree Road, Alpharetta, Ga. 30201; (404) 475-1818.

1985 Measurement Science Conference, Jan. 17-18. Marriott Hotel, Santa Clara, Calif. Darlene Diven, Lockheed Missiles and Space Co., PO Box 3504, Sunnyvale, Calif. 94088; (408) 756-0270.

Uniform, Jan. 21-25. Infomart, Dallas, Texas. Pemco, Inc., 2400 E. Devon Ave., Suite 205, Des Plaines, Ill. 60018; (800) 323-5155.

Communication Networks Conference and Exposition, Jan. 28-31. Washington Convention Center, Washington, D.C. Louise Myerow, CW/Conference Management Group, 375 Cochituate Road, PO Box 880, Farmingham, Mass. 01701; (617) 879-0700 or (800) 225-4698.

ULTIMATE

FERRORESONANT LINEAR SWITCHING



POWER SUPPLIES

When You Require The Highest Quality Supply, NJE Has The Power... to supply you with reliable, high-performance switchers. We offer over 30 standard models, each made to our exacting standards that meet (actually exceed) CSA and UL requirements.

Backed By The Most Dedicated Customer Support Team In The Industry. From our 5 year warranty on every power supply to on-going product development to our unsurpassed customer support, our commitment to quality is second to none. We offer the power to deliver. To customize. To provide the support you need. Whether you need quality switchers, or linears and ferroresonants. Our technology coupled with dedicated service adds up to providing you with the ultimate in power supplies.

Call us today for our complete catalog, for specs., quotes or for any other information your application may require. Call (800) 526-2439 TODAY.

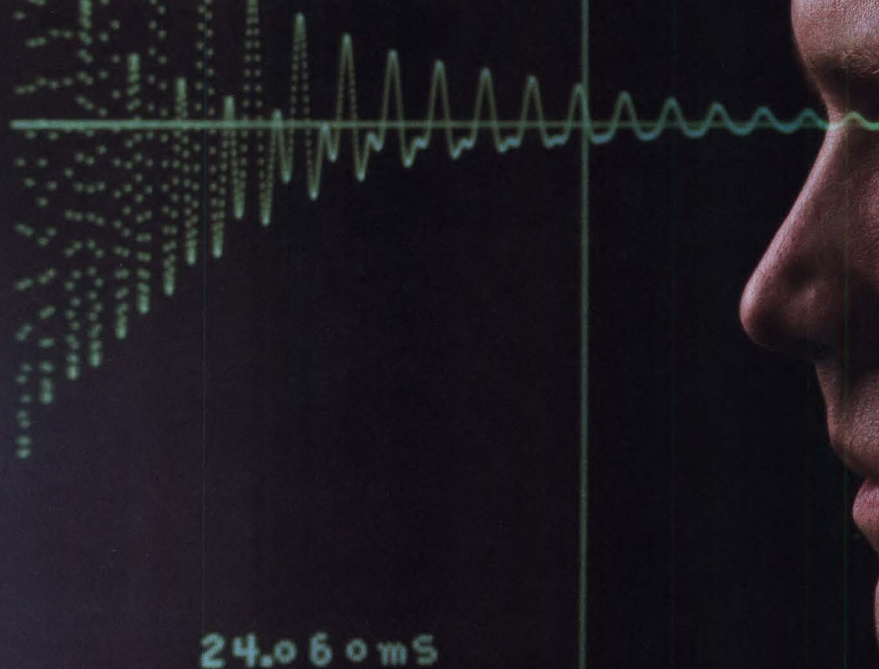


NJE POWER SUPPLIES
329 Culver Road
P.O. Box 669
Dayton, NJ 08810-0669

**POWEReliability.
Guaranteed.**

THE NICOLET 2090 DIGITAL OSCILLOSCOPE

TAKE A CLOSER LOOK AT WHAT YOU'VE BEEN MISSING.



DIGITAL PRECISION AND RESOLUTION LIKE YOU'VE NEVER SEEN.

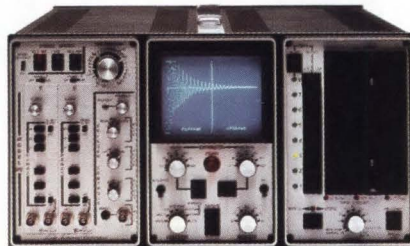
Picture this. The smallest detail in *12-bit resolution*, expansion to X64, with voltage and time coordinates alphanumerically displayed. Plus the ability to record 4K data points at *speeds up to 50MHz*, with the 205A plug-in. It's what you'd expect from the digital oscilloscope that's still setting the standards—Nicolet's 2090.

DON'T MISS ANY TRANSIENTS.

The 2090 offers push button transient capture, at speeds selectable from 20 nanoseconds to 200 seconds per point, so you can record fast or slowly changing signals with ease. And *pre- and post-trigger capture* lets you see what led up to an event as well as what followed. Built-in floppy disk allows unattended operation . . . just set and forget.

THE VERSATILITY YOU'VE BEEN LOOKING FOR.

Optional RS232 and IEEE-488 bidirectional interfaces give you the ability to coordinate and manipulate data by remote computer. That means



the 2090 scope can be the front end of an entire analysis system. Not only that, the 2090's modular design allows you a choice of *four different plug-*

ins. Pick the digitizer that's designed for your present application, and add other plug-ins to fit your expanding needs in the future.

SEE FOR YOURSELF.

Let us show you how easy the 2090 is to use. It's time *you* started benefiting from the tremendous digital advantage. Call us: (608) 273-5008. Or write: Nicolet Oscilloscope Division, 5225 Verona Road, Madison, WI 53711.

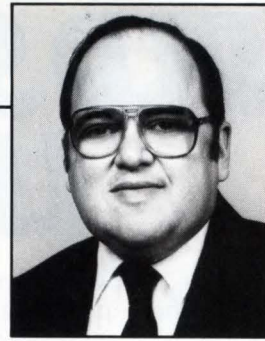
BRINGING DIGITAL PRECISION
TO AN ANALOG WORLD



Nicolet

PERSONALLY SPEAKING

Bipolar buckles down to hold its own against CMOS and GaAs



Bipolar technology's reign as the dominant approach to logic circuitry is now facing its greatest challenge. The ensuing war for supremacy will consist of two campaigns. On one front, CMOS continues to make major inroads into MSI and SSI—once primarily bipolar's domain. On the other, gallium arsenide is looking to gain a stronghold both in memory and in high-speed logic. Indeed, the threat posed by alternative technologies is even greater now than during the 1970s. It was at that time that speed improvements in NMOS and advances in MOS density sharply curtailed the use of bipolar for dynamic RAMs.

With ever greater frequency, companies are committing new designs to CMOS. Even proprietary circuits that were originally built or planned in bipolar are being redesigned in CMOS. Many of the latest data converters and digital signal processors, for example, are taking the CMOS route.

One of the battles that bipolar must fight revolves around the time it takes to design devices. The goal, as always, is greater productivity. But bipolar's high speed makes the design process inherently more complex than it is for MOS, since a greater variety of active circuit elements must be integrated. MOS, in contrast, takes advantage of structured elements like memory arrays and programmable logic arrays. Such reusable blocks make the task simpler and permit greater circuit flexibility.

Further, the drive to make CMOS logic faster puts the pressure on designers to squeeze even more speed from bipolar. Line widths of $2\mu\text{m}$ and less have already proven possible in 64-kbit CMOS static RAMs, and engineers are quickly translating that success into CMOS logic. The feeling is that CMOS will soon catch

up with the bipolar FAST and ALS families, offering a power dissipation advantage to boot. Nevertheless, bipolar ECL will maintain its premier position when the fastest logic is demanded.

Meanwhile, although the jury is still out on gallium arsenide, the outlook for GaAs MESFET and HEMT (high electronic-mobility transistor) logic appears quite promising—especially in high-speed cache memory and logic. GaAs delivers lower power dissipation, higher density, and higher throughput than conventional bipolar techniques. It is, however, several times more expensive than is bipolar.

Despite these struggles, bipolar designers are far from giving up. New processes—or at least updated versions of older ones—are going into production, and efforts are under way to boost performance levels.

At Texas Instruments Inc. (Dallas), for instance, a version of the company's Impact process—with walled emitters and arsenic doping—is now in full swing. Taking advantage of step-and-repeat exposure equipment and dry etching, it is yielding bipolar devices with $2\mu\text{m}$ features. The plan is to reach $1\mu\text{m}$ and below for programmable logic arrays and PROMs. At Advanced Micro Devices Inc. (Sunnyvale, Calif.), the performance of its advanced bipolar circuits is being extended with new bipolar standard cells.

Quite clearly, bipolar technology has no intention of standing still while under attack.

Martin Gold

Martin Gold

NOTHING IN THE WORLD SUPPORTS OEMS LIKE Q-BUS.

Few companies could legitimately promise you either the experience or the insight into the OEM market that has helped make Digital the number one choice and world's leader in systems and 16-bit components.



With well over 25 years' experience behind us, we've learned quite a bit about what it takes to be a good OEM and how we can help.

We're aware of your concern for reliability and dependability. With your name on the product, you're naturally the first one to get any calls.

We appreciate the deadlines you're forced to deal with. And your need for the thorough documentation and manufacturer's support that can help you beat your competition to market.

We also understand the commitment you make when you select an architecture. And your need for support of that architecture. Not just from the manufacturer, but from third party sources as well.

These are precisely the reasons to choose Digital's Q-Bus* architecture. Because only

Q-Bus gives you the proven products and technologies, the flexibility, the commitment and support to help you reach your market. On time. And on target. With a minimum of risk.

CHOOSE THE INTEGRATION LEVEL THAT'S MOST PRACTICAL FOR YOU.

Q-Bus is nothing if not flexible. And that flexibility begins with the level of integration you

choose. From chips to boards to boxes to complete systems.

You may, for instance, have the time and resources to develop your own system around one of our J11* microprocessors, thus helping to reduce your hardware costs.

On the other hand, if deadlines are tight, you might opt for one of our complete supermicro systems like the Micro PDP-11*, the Micro PDP-11/73* or the powerful 32-bit MicroVAX I*. By

radically reducing development time, perhaps almost eliminating it altogether, you increase your chances of beating your competition to market, thus permitting you to earn the higher margins available at the beginning of a product life cycle.

If your needs fall somewhere in between, we recently introduced three board level CPU products to work with. Our LSI-11/73* microprocessor, a new CMOS microcomputer that benchmark studies show exceeds the performance of a similarly configured MC68000* or NS16032* in most applications.

Our KXT11-C* peripheral processor, which for the first time allows you to place multiple PDP-11* processors on the Q-Bus, assigning separate tasks to each.

And our Falcon-PLUS* single-board computer, one of the smallest 16-bit single-board computers for dedicated or limited RAM applications. In addition, you have two versions of Micropower/Pascal* system software available to you for use in VMS* or RSX* development environments.

Digital's new board-level products also take full advantage of the Q-Bus' block mode transmission, which effectively doubles previous throughput to nearly 3 megabytes per second. That means Q-Bus—along with these new products and future generations—will be running strong well into the future with the full commitment of Digital behind them.

ENGINEERING APPLICATIONS	UTILITIES MANAGEMENT
MEDICAL/FINANCIAL SYSTEMS	METAL FABRICATION SYSTEMS
OCR DATA ENTRY	WOOD & PAPER PROCESS CONTROL
CUSTOMER SYSTEMS	ELECTRONIC INSTRUMENT TESTING
EDUCATIONAL RESEARCH	PUBLIC UTILITY QUALITY CONTROL
BUSINESS INSURANCE	WHOLESALE BUSINESS ADMINISTRATION
X-RAY DATA COLLECTION	MINING PROCESS CONTROL
CREDIT PAYMENT COLLECTION SYSTEM	SCIENTIFIC LAB DEVICES
HIGH SPEED DATA/FILE	BACKTRACK BETTING EQUIPMENT
COMMUNICATION SWITCH	DATA COLLECTION DEVICE
INSPECTION SYSTEM FOR P.C. BOARDS	REALTIME CONTROLLERS
TELEPHONE INDUSTRY EQUIPMENT	PROCESS CONTROL
FINGERPRINT ID	DESK TOP GRAPHICS
ROBOTICS	ENERGY MANAGEMENT SYSTEM
EARTH STATION ANTENNA CONTROLLERS	GRAPHICS SYSTEMS
TORQUE DETECTION	COMPUTER BACKPLANE TESTER
SOFTWARE DEVELOPMENT	DATA ANALYSIS SUBSYSTEM
MOBILE COMM TERMINAL INSTRUMENTATION	PORTABLE COMPUTER
CAT SCANNERS	COPY FRONT-END PROCESSOR
DATA ACQUISITION	GRID TEST STAND
INTELLIGENT CONTROLLERS	INDUSTRIAL PROCESS CONTROL
MILITARY NETWORK COMMUNICATIONS	CLUSTER STATION CONTROLLERS
WORKSTATION CONTROLLER	RELAYRIPS
DATA CONCENTRATORS	SUPERSON PUMP
CABLE TV CONTROLLER	TYPESETTING
MEDICAL BUILDING SYSTEM	HYDRAULIC ELEVATORS

COMMERCIAL CONTROLS	TO SUBSTATION FROM TRANSMISSION SYSTEM
POINT-TO-POINT COMMUNICATION TO NETWORKS	UNIVERSAL THERMAL ANALYZER
IMAGE PROCESSING	FLUORIMETER/SCINTILLATOR FOR X-RAY ANALYSIS
FACTORY TOOL CONTROLLER	COMMUNICATION MULTIPLEXERS
COMMUNICATIONS	DATAWARE MANAGEMENT
SMALL BUSINESS SYSTEMS	MULTI-USER WORKSTATION
COMPLEX THERMOGRAPHY	RESEARCH CONTROLLER
MEDICAL OFFICE SOFTWARE	IMMUNOASSAY
DATA ACQUISITION SYSTEM	CYBER-AR GAMES
IMAGE-AND PROCESSOR	GRAPHICS BOARD FOR WORKSTATION
DATA FILE MANAGEMENT CONTROLLER	DEADWEIGHT CONTROL
FILE SERVER, NETWORK CONTROLLERS	INTELLIGENT AND GRAPHICS TERMINAL
CLUSTER STATION CONTROLLER	TELEPHONE NODE CONCENTRATOR
DESK TOP COMPUTER	SIGNAL PROCESSING
GRAPHICS TERMINAL	NETWORK, TEL. LINEAR MODEM
COM. FILE, FILE, BOARD	GRAPHICS WORKSTATIONS
DEVELOPMENT/INSTRUMENTATION CONTROLLER	MATERIAL PROCESS CONTROL

And since all are based on the industry standard PDP-11, you get the best of both worlds. Advanced capabilities. With proven technologies. So you become more competitive with less risk.

COMPATIBILITY MEANS MORE FLEXIBILITY. LESS REDEVELOPMENT.

From the beginning, Digital has been dedicated to a single philosophy with its product families. Compatibility. Not just from product to product. But from generation to generation.

To the OEM, that's particularly important because it means you can upgrade your product at any time you like, with an absolute minimum of development.

Suppose, for instance, you designed around the world's first 16-bit microcomputer, our LSI-11* microprocessor. And now you find that new demands on your product require a more powerful system. Upgrading your processor to our LSI-11/23* microprocessor or LSI-11/73 microprocessor is a simple matter. You don't need to learn a new operating system. And the changes to your software are absolutely minimal. With Q-Bus, instead of going back to the boards and starting over, you move your product to market. Faster. With far less expense.

MORE THIRD PARTY SUPPORT THAN ANY OTHER ARCHITECTURE IN THE WORLD.

Your advantages continue with the broad choice of peripherals available to you.



Q-Bus is not only supported by Digital's own line of processors and peripherals, but by those of any number of third party

ENGINEERING MONITORING	WAREHOUSE SYSTEMS
ELECTRONIC FUNDS TRANSFER	AUTOMOBILE EMISSION LAB
ADDRESSABLE CATV CONTROL SYSTEMS	OIL FIELD AUTOMATION
BUILDING AUTOMATION	SIGNAL PROCESSING
ACCESS CONTROL ENERGY MANAGEMENT	MEDICAL ELECTRONICS
GRAPHIC ARTS	REALTIME TRAFFIC SIGNAL CONTROL
MILITARY ELECTRONICS	LASER MACHINE CONTROL
LIBRARY AUTOMATION	WATER PRODUCTION & CONTROL SYSTEMS
COMPUTER-AIDED DISPATCH	TRAFFIC CONTROL
MEDICAL IMAGING	CORPORATE SECURITY SYSTEMS
SIMULATION LAB	X-RAY SPECTROSCOPY
REMOTE COMPUTER SYSTEMS	VISION SYSTEMS
MICROPROCESSOR DEVELOPMENT	TEST SYSTEM CONTROLLERS
PUBLICATION TYPESETTING	NEW EQUIPMENT DESIGN
SEISMIC MAPPING	RESTAURANT TURNKEY SYSTEMS
TEST WAFERS	MICROFILM & IMAGE RETRIEVAL
FACTORY AUTOMATION	ELECTRIC UTILITY INDUSTRY
INSTRUMENT CONTROL DATA ANALYSIS	NAVIGATION
PROGRAMS FILING	HANDPRINT RECOGNITION
ELECTRIC UTILITY	MACHINE CONTROL

PETROL INDUSTRY	LIFE AND SCIENCE RESEARCH
PIPELINE AUTOMATION	PHYSICS RESEARCH
TELEPHONE CALL ACCOUNTING	OCCUPATIONAL HEALTH
MESSAGE SWITCHING	HOSPITAL DEPARTMENT SYSTEMS
POWER PLANT MONITORING	ENGINEERING SCIENCE RESEARCH
TELEPROCESSING	RADIOLOGY
COLLEGE COMPUTING CENTER	TEXT/DOCUMENT MANAGEMENT
MACHINE TOOL CONTROL	HUMAN RESOURCE PLANNING
VISUAL INFORMATION DISPLAY	OPERATIONS RESEARCH
SURFACE SCIENCE LASER DIODE TEST	GENERAL ACCOUNTING
ARTIFICIAL INTELLIGENCE DEVELOPMENT	DECISION SUPPORT SYSTEMS
VIBRATION ANALYSIS	OFFICE AUTOMATION
GENERAL ADMINISTRATION	GENERAL TIMESHARING
INDUSTRY SPECIFIC MIS	CENTRAL COMPUTING
INVENTORY	DATA PROCESSING
BUSINESS MANAGEMENT	MACHINE TOOL TESTING
MACHINE & PROCESS CONTROL	WEATHER DISPLAY SYSTEMS
QUALITY MANAGEMENT	OEM INSTRUMENTATION
QUALITY CONTROL LABS	ACCOUNTING DISTRIBUTION SYSTEMS
STRUCTURAL ANALYSIS	COLOR WEATHER GRAPHICS
CIVIL ENGINEERING	SOFTWARE DEVELOPMENT
EARTH RESOURCE MANAGEMENT	SECURITY CENTRAL STATION
COMPUTER AIDED DESIGN	WELL LOGGING
ELECTRONIC ENGINEERING	PROJECT CONTROL
MATERIALS RESOURCE PLANNING	GRAPHICS, FILING
AUTOMATED MATERIALS HANDLING	DATA REDUCTION
ACADEMIC COMPUTATION	OPTICS

COMPUTER BASED EDUCATION	RESEARCH & DEVELOPMENT
COMPUTER AIDED MANUFACTURING	TEST APPLICATIONS
CHEMICAL RESEARCH	IMAGE PROCESSORS & MANUFACTURING
FACTORY CONTROL	SIGNAL PROCESSING
AUTOMOBILE EMISSION TEST	MESSAGE PROCESSING SYSTEMS
INFORMATION & CONTROL SYSTEMS	TELECOMMUNICATIONS EQUIPMENT
BUILDING MANAGEMENT	VOICE STORAGE
CORPORATE ENGINEERING	ELECTRONIC MAIL
MICROPROCESSOR DATA ENTRY	TRAINING MANAGEMENT
BOARD TESTING	SUPERVISORY CONTROLS, GAS
FACILITY MANAGEMENT	RECORDS MAINTENANCE
HEALTH CARE	X-RAY
MEDICAL TEST EQUIPMENT	BUILDING AUTOMATION/ENERGY MANAGEMENT
SALES & COST TRACKING	AGRICULTURAL RESEARCH
MARK READING	ADMINISTRATIVE & ACADEMIC
NUMERICAL CONTROL	SUPERVISORY CONTROL, OIL
ROBOTICS CONTROL	HIGHER EDUCATION ADMINISTRATIVE/ACADEMIC
MACHINE VISION DEVELOPMENT	VOICE INPUT/OUTPUT
ELECTRONIC FILING SYSTEMS	RESEARCH & DEVELOPMENT TESTING
SOFTWARE DEVELOPMENT	SALES INFORMATION SYSTEMS ELECTRONIC
FILING SYSTEMS	PRODUCTION CONTROL
RECORDS MANAGEMENT	ELECTRICAL CONTROL
DATA TRANSMISSION	PROCESSING ELECTRIC LOGS
ARTIFICIAL INTELLIGENCE RESEARCH	X-RAY MICROANALYSIS
INSTRUMENTATION ANALYSIS	REALTIME I/O
MACHINERY MONITORING	PSYCHOLOGICAL TESTING
TRANSPORTATION DISPATCH	DIGITIZING & GRAPHICS

MICROPROCESSOR SYSTEMS DEVELOPMENT	SECURITY MONITORING
AUTOMATED MATERIALS HANDLING	CAO CONTROL
INDUSTRIAL INSTRUMENTATION	INVENTORY BILLING
DESIGN & TESTING FABRICATION	SYSTEM INTEGRATION
SCIENTIFIC CONTROL	SYSTEMS CONFIGURATIONS
MEDICAL INSTRUMENTATION	MANUFACTURING TAPES

sources as well. From memories to mass storage to a complete range of I/O interfaces.

So chances are, you can design your custom system around existing hardware, rather than developing your own or working around someone else's limited product offering. And you may modify your product later with little concern over development costs or delays.

BEST ENGINEERED MEANS ENGINEERED TO A PLAN.

Digital's Q-Bus products, like all Digital hardware and software products, are engineered to conform to an overall computing strategy. This means that our systems are engineered to work together easily and expand economically. Only Digital provides you with a single, integrated computing strategy, from chips to 32-bit VAX systems, and direct from desktop to data center.

For more information about Digital's OEM products, simply fill out and return the coupon below. Or contact one of Digital's Authorized Industrial Distributors. Or call 1-800-848-4400, ext. 139. In Canada, call 617-542-6283.

- ☐ Please send detailed product specifications.
☐ I'm in a hurry. Have your representative call today.

Name _____
 Title _____
 Company _____
 Address _____
 City _____
 State _____ Zip _____
 Telephone _____ Ext. _____

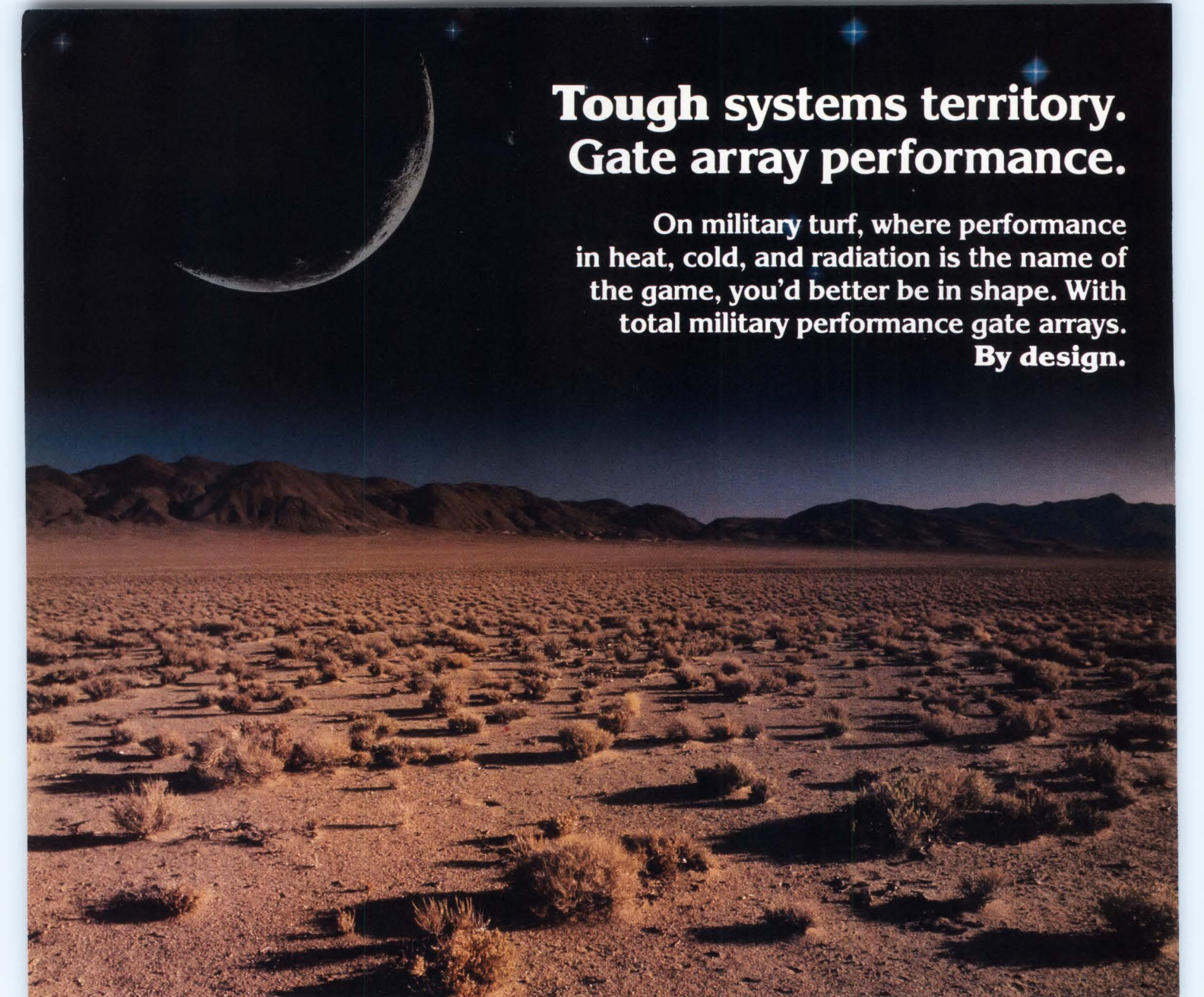
Digital Equipment Corporation,
 77 Reed Road, HL02-1/E10,
 Hudson, MA 01749.

THE BEST ENGINEERED COMPUTERS IN THE WORLD

ED-10/31/84

digital™

"SEE US AT WESCON
 BOOTH #3281"



Tough systems territory. Gate array performance.

On military turf, where performance in heat, cold, and radiation is the name of the game, you'd better be in shape. With total military performance gate arrays. **By design.**

Raytheon Semiconductor Division designs for military performance: Refined bipolar technology designed from scratch expressly for high speed, low power and radiation tolerance over the full military operating temperature range. Double the speed and half the power of LS. Documented radiation hardness.

Service and support: Complete in-house integration of design and manufacturing. Fully automated CAD (including conversion from logic simulation to placement and routing, linkage between logic simulator and tester).

Credentials: Trident II, Milstar, F-111, F-15, F-16, F-18, B-1, SICBM, JTIDS, AIM-7M, Patriot, ALQ 135 and other programs.

Advanced technology: Five array densities from 800 to 2400 gates. Efficient Integrated Schottky Logic (ISL) bipolar technology. 2.3nS, 350 μ W (typ) gate performance . . . for 0.8pJ speed-power product. Selective enhancement to 1.8nS.

Call Raytheon Semiconductor Division: Specifications, application notes, technical and cost proposal for your application. **415/966-7716.**

*Advanced Analog and Digital VLSI Products for
Commercial and Military Applications*



Access to the Right Technology

NEWSPULSE

600-Mybte audio disks poised for personal computers

Personal computers, which already have a host of storage options at their disposal, will gain one more in the coming year—600-Mybte compact audio disks. The platters, which are 4.72 in. in diameter, retain the equivalent of 1200 floppy disks. From 3M Co.'s Optical Recording Project (St. Paul, Minn.), the disks are intended for read-only laser systems and will use substrates from NA Philips Corp. (New York City). 3M also will work with Philips's equipment to furnish master disks, much the same as it does for larger optical platters.

The disks are set up using Philips's standard audio format. Although they play on an audio-disk drive, linking the drive to the computer requires some modifications, mainly to the interface.

LCD shutter challenges laser print heads

Laser printing mechanisms employed in low-cost printers have found a rival in a microprocessor-controlled shutter based on a liquid-crystal display. In operation, light from an ordinary fluorescent lamp is guided onto an LCD panel, which is electrically excited to form specific characters. In front of the panel is a lens array that focuses the light passing through the LCD on the printer's photosensitive drum. The shutter, unlike its laser counter-parts, has no moving parts, making it relatively maintenance-free. Originally meant as part of the GQ-3000 LCS printer, from Epson America Inc. (Torrance, Calif.), the shutter is also available separately.

Six-transistor cell to find a home in static RAM

ACMOS RAM may be the first beneficiary of a six-transistor static memory cell that accesses in as little as 55 ns—making it one of the speediest static RAMs available. The 2k-by-8-bit chip, from Mosel Inc. (Sunnyvale, Calif.), will be fabricated with a 2- μ m silicon gate, dual-well process. It is expected to consume about 250 mW when active and merely 5 μ W on standby. With the help of some proprietary layout tricks, designers can keep the area of the memory cell to less than 1 mil², in turn holding down chip size. The RAM, which is slated for sampling later this year, will also be able to retain data with voltages as low as 2 V.

Workstation cost plunges with optical scanners, 3 μ Ps

A high-resolution graphics workstation that combines a proprietary optical scanning and alignment scheme with three microprocessors comes in at half the cost of comparable systems—\$150,000, including all software. A 68000 microprocessor locates a precise point on a hand-drawn engineering schematic and converts it into vector data at 300 dots/in. A light source and a photodiode detector actually scan alignment squares located on one edge of the drawing. Whereas conventional systems must wait for a complete scan before converting data, this vector generator scans and converts information on the fly, thus speeding up the process and significantly reducing the need for memory. Another 68000 controls communication

NEWSPULSE

between the vector generator and the display. An 8086 controls the structure of the vector data, and graphics software translates the vector data into high-level commands. All processing functions are performed locally, eliminating the need for host computer processing. The 4991S1 workstation from Tektronix Inc. (Beaverton, Ore.) also includes host computer data-base interface software, a CRT display, and a graphics tablet for user interaction.

Subprocessor array adds new twist to parallel processing

Packing an array of subprocessors on a single chip, with dedicated circuits executing particular tasks and algorithms, is a unique approach to parallel processing. Conventionally, such processing is taken care of by wiring together a number of microprocessors. The KSC2408 chip instead employs eight separately programmable second-order filters. They can run simultaneously to crudely filter eight signals, or they can be set up serially for ultraprecise filtering of larger signals. The chip operates at 6 MHz and will be available soon from the Kurzweil Semiconductor Division of Kurzweil Applied Intelligence Inc. (Waltham, Mass.). It carries out 24-bit arithmetic to a resolution of 24 bits.

Simulator competes head-on with popular software

One of the latest entries into the IC simulation race outpaces the popular TEGAS simulator two to one, and with an optional hardware accelerator it could further boost that speed a hundredfold. The simulator, part of the LDS III design package from LSI Logic Corp. (Milpitas, Calif.), also captures schematics, verifies circuit operation, computes delays, generates test vectors, and grades faults. Optionally, it can simulate multiple chips, with the user specifying the interchip loading capacitance and the timing for each individually developed chip. Written in C, the software runs on workstations from Daisy Systems, Mentor Graphics, and Valid Logic, as well as on single-user Unix computers, Digital Equipment's VAX 11/780, and IBM's 3081 mainframe.

Licensing pacts share proprietary device and cells

Across-licensing agreement puts a raster controller chip, from Sun Microsystems Inc. (Mountain View, Calif.), into the hands of VLSI Technology Inc. (Milpitas, Calif.). Fabricated in HMOS, the chip scrolls screens, manipulates windows, draws vectors, and paints characters on both monochromatic and color displays. Its internal data paths are 16 bits wide, and it exercises 256 functions to map destination, source, and pattern registers into 16-bit outputs.

In a related move, VLSI agreed to supply Lattice Semiconductor Inc. (Portland, Ore.) with wafer fabrication, assembly, testing, and product engineering for all of Lattice's present and forthcoming devices. In addition, the pact gives VLSI the right to expand its application-specific cell library to include such Lattice-designed functions as high-speed RAM cells.

**YOU OWE IT TO YOURSELF
TO CHOOSE FROM THE BEST.**

Choosing the right logic analyzer can be tough. But one thing is clear—you want all the advantages you know you can count on from the performance leaders.

**EVEN AMONG THE LEADERS,
THE DIFFERENCES CAN BE
SIGNIFICANT.**

For example, not all the top logic analyzers give you 200 MHz timing. Or highly sophisticated linkage and interactive analysis. Or 1000-word deep data collection and auxiliary memories. Or an easy-to-use ASCII keyboard. Or floppy disk data storage. *Only Nicolet's 800*

series gives you all these advantages. In the end, though, it's Nicolet's unmatched price/performance ratio that's the most important difference.

**SOME LOGIC ANALYSIS SYSTEMS
GROW WITH YOUR NEEDS.
SOME DON'T.**

Only Nicolet makes it easy and inexpensive to enhance *performance*—not just add channels—any time you need it. And the NPC-800 Series gives you *five* instruments to choose from starting at \$7950, and more options than anyone else in the industry: Waveform Recorder, Performance Analysis, CT/SA, Computer/IEEE-488 Controller, Printer Software, Non-Volatile Memory, Dot Matrix Printer, and Second Disk Drive.

PUT THE LEADERS TO THE TEST.

When you really think about it, the only way to be sure is to let the best logic analyzers prove what they can do—for *you*. When it comes to capability, versatility, and performance, there's really only one choice. For a Logic Analyzer Comparison Chart, call: (800) NICOLET or (415) 490-8300 (inside CA). Nicolet Paratronics Corporation, 201 Fourier Ave., Fremont, CA 94539.

Think of us!

Nicolet
CIRCLE 19

THE WORLD'S THREE GREAT LOGIC ANALYZERS.

Gould Logic Analyzers

Introducing the K105. No other logic analyzer is so easy to use.

Logic analyzers have always been a bit complicated. Perhaps even intimidating to the occasional user. No more.

When you sit down at our new K105 logic analyzer, the first thing you'll notice is that big, friendly red HELP button. Press it. You'll begin to feel better immediately.

You see, we wrote the book on logic analyzers. And now the book is in the machine. So when you press the button, you display easy-to-understand, step-by-step operating instructions right across the bottom of the screen. While the data from the operation you're performing remains on the screen.

And if you're still in trouble, just press again. The HELP button and an adjacent SHIFT button call up a HELP MENU and 28 pages of detailed instructions on every analyzer function.

We'll say it again. No other logic analyzer is so easy to use.

Modular design accommodates application changes.

The K105 isn't just easy to use. It's accommodating, too. By simply swapping boards, you can configure several different logic analyzers.

For instance, you can select up to 64 20 MHz channels in 32-channel increments for microprocessor analysis. Up to 16 100 MHz channels in 8-channel increments for hardware analysis. Or combine them to a maximum of 72 channels for software/hardware integration tasks.

And there's more. You can add a dual 5¼" floppy disk drive (IBM CP/M 86™ compatible) to store up to 70 setups or data files. While providing data portability and post-processing capabilities.

Disassemblers and Trace Control™ speed software debugging.

It's a lot easier to debug software when you can get your system's microprocessor to speak assembly language mnemonics rather than object code. And our disassembly modules for the 68000,

8086, 8088, 8080, 8085A and Z80®B do just that.

And with the K105's 8 levels of Trace Control at 20 MHz, you can isolate and capture widely-separated slices of program flow to pinpoint failure causes... in a fraction of the time it would take with a conventional triggering scheme.

Two-analyzers-in-one enhances software/hardware integration.

When you're integrating hardware and software, the K105 is two analyzers in one. Just combine the 20 MHz and 100 MHz options to look at both state and timing. For trouble-shooting multi-processor systems, you can even monitor both processors and capture the asynchronous data between the two.

And the K105 offers a fast 5 ns glitch capture capability to pinpoint hard-to-find random problems.

Plus high-speed sampling for hardware analysis.

For high-speed sampling, you can configure the K105 with up to 16 100 MHz

To Simplify Logic Analyzer Operation, Press Here.

Clearly the Best.

channels. Our unique automatic noise margin analysis feature enables you to verify specified system thresholds on as many as 16 channels simultaneously.

And design verification is simplified by a "don't care memory" that allows you to selectively mask out memory portions so you can compare only those portions you want to see.

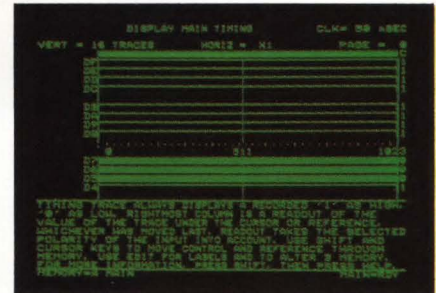
Uncompromising dedication to high performance.

The Gould philosophy dictates that every instrument we make be the best for the job it's designed to do.

The K105, with its unsurpassed ease-of-operation and modular flexibility to perform a wide range of analysis tasks, is evidence of that dedication.

For detailed application notes or a demonstration, write Gould, Inc., Design & Test Systems Division, 4600 Old Ironsides Drive, Santa Clara, CA 95050-1279.

For fastest response, call toll-free: Nationwide (800) 538-9320; In California (800) 662-9231 or (408) 988-6800.



The K105 offers you two levels of HELP at the press of a button. The first displays step-by-step operating instructions across the bottom of the analyzer screen. The second brings a menu to the screen, allowing you to select more detailed help from an integral 28-page manual.

CIRCLE 20



HELP



 **GOULD**
Electronics



Watch 5,000 gates take shape in an instant.

What if you could build a VLSI logic device in just a few hours? Instead of months.

And control every step of the process? Instead of relying on outside vendors.

Or change your design for just a few dollars? Instead of a fortune.

Maybe you should be using a MegaPAL™ array.

Instead of a gate array.

Our newest MegaPAL array, the PAL64R32, offers 5,000 gates of logic.

And to turn it into the design of your dreams, all you need is our enhanced PALASM™ CAD software.

It's easy to use. And it's fast.

How fast?

With a MegaPAL array and PALASM software, you can design, simulate and program a complex VLSI logic component in just a few hours.

You can produce a fully-testable prototype about as fast as you can say it. And, of course, you can change your design just as easily.

Then, when you're ready for volume production, you can turn out as many MegaPAL devices as you need. Or convert to mask-programmed MegaHAL™ arrays.

Sound easy?

Well, to make sure it is, we even offer a comprehensive training program that'll get you up to speed in no time.

MegaPAL arrays.

The instant alternative to gate arrays.

Call your local Monolithic Memories representative or franchised distributor for our PAL64R32 data sheet and MegaPAL brochure.

Monolithic Memories, 2175 Mission College Blvd.,
Mail Stop 9-14, Santa Clara, CA 95054.

MegaPAL, MegaHAL and PALASM are trademarks, PAL is a registered trademark of Monolithic Memories, Inc. ©1984 Monolithic Memories, Inc.

TI creates IMPACT

These pace-setting devices from Texas Instruments operate at unprecedented clock speeds up to 50 MHz. They can cut processing time in half for such speed-critical applications as high-resolution graphics for CAD/CAM systems. New superminicomputers. Artificial intelligence machines. Wherever complex functions demand extremely large numbers of logic operations for rapid image access, use TI's new IMPACT bipolar PAL® ICs (TIBPAL-15 Series).

Propagation delay cut by 40%

TI's unique 2- μ m Implanted Advanced Composed Technology (IMPACT) dramatically reduces the size and the sidewall capacitance of circuit elements (see facing page). Establishes a new performance standard with propagation delay cut to 15 ns, maximum, at 180 mA—versus 25 ns at 180 mA for the fastest PAL ICs formerly available.

Space requirements cut by up to 83%

With their extremely dense circuitry, TIBPAL-15 Series devices can bridge the gap between SSI/MSI and LSI gate arrays. Now a single PAL IC can replace as many as six SSI or MSI circuits. And give you the flexibility of user-programmable logic in such fields as telecommunications and automotive control, where space constraints—as well as processing speed—are often critical.

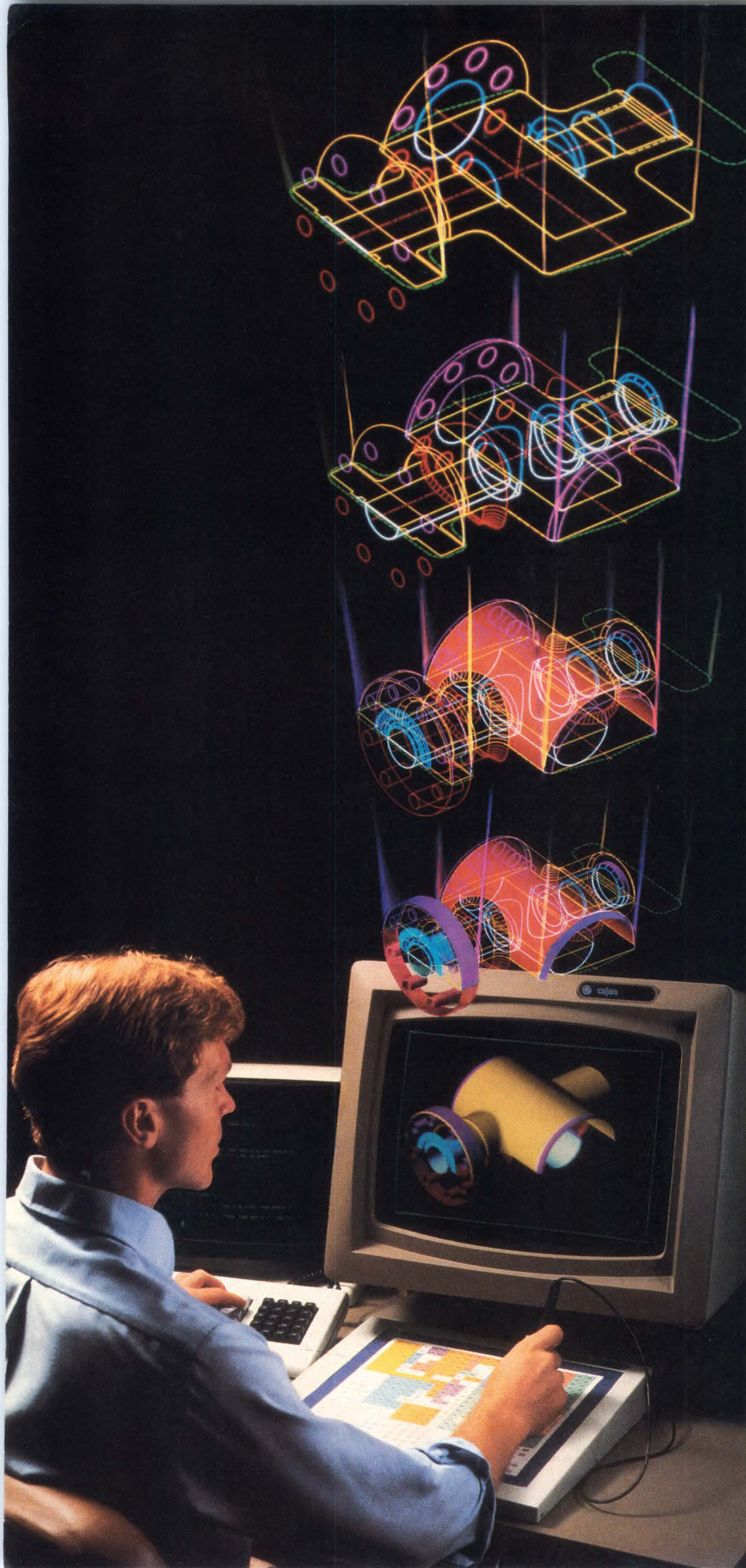
Fast and easy programming

Programming TIBPAL-15 Series bipolar logic circuits, with their reliable titanium-tungsten fuses, takes only seconds using widely available software and inexpensive device programmers. And you can implement logic-design changes in minutes, without vendor retooling.

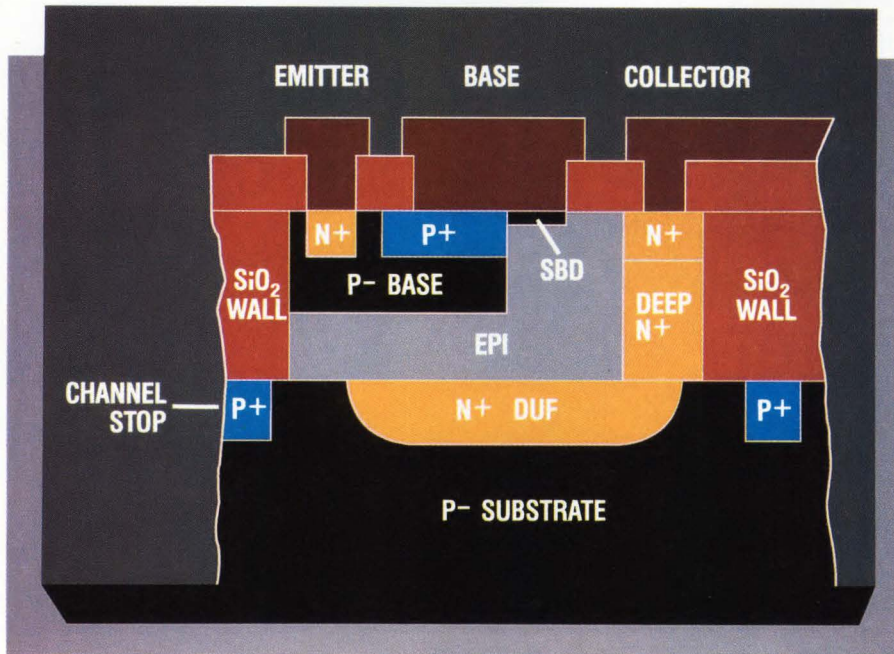
For any logic application where superspeed, high density, and immediate availability are design criteria, your best—and only—answer is a 15-ns PAL IC from Texas Instruments.

◀ **Processing 50 megabits of digitized data per second**, TI 15-ns PAL ICs will find widespread application in advanced, high-resolution graphics for CAD/CAM systems. These new superspeed PAL ICs can enhance performance by increasing both the speed and the size of the graphics-display processor.

Demonstration software courtesy of Calma Company.
® PAL is a registered trademark of Monolithic Memories, Inc.
27-4990
©1984 TI



the world's fastest PAL ICs: New process delivers 15-ns speed.



A highly significant reduction in capacitance results from the 2- μ m feature size which TI's IMPACT processing makes possible. Silicon dioxide is the isolation material. Switching speed is further enhanced by utilizing this silicon dioxide for emitter and base sidewalls.

TI's new IMPACT technology boosts circuit density and performance levels.

IMPACT is a unique innovation of Texas Instruments, capitalizing on the advantages of composed-masking techniques to increase the speed and density of bipolar integrated circuits.

Composed masking yields high density

In composed masking, critical components are placed on the chip with a minimum number of masks. Thus they can be more tightly defined and more densely spaced than by conventional masking, which requires more precise registration.

The process also makes it possible to insulate critical base and emitter components with oxide walls. This insulation reduces sidewall capacitance, which at the dimensions of IMPACT features can represent as much as half the overall capacitance. Small size and oxide

walling together contribute significantly to the increase in switching speed.

Other important features of IMPACT technology are independently controlled base resistance and double-level metal with a 7- μ m pitch at the first level.

Exceptional reliability built in

The high speed, low power, and potential for large-scale integration that IMPACT makes feasible are valuable characteristics for chips used in harsh environments. Improved electrostatic-discharge (ESD) tolerance has been designed in. Copper-doped aluminum in the first-level interconnection eliminates electromigration during programming. Current densities, metal spacing, and contact sizes are all conservatively designed to add reliability to the process.

Also from TI: The world's fastest FPLAs.

In addition to superspeed TIBPAL-15 Series ICs, Texas Instruments offers the industry's fastest Field Programmable Logic Arrays (FPLAs), with 20-ns maximum gate delay.

Whereas PAL ICs have a programmable AND array feeding a fixed OR array, the universal structure of the FPLA includes programmable AND and OR arrays. The FPLA provides the ultimate flexibility for implementing logic functions in the "complexity gap" between standard SSI/MSI and LSI/VLSI logic.

The wide range of programmable-logic devices available from Texas Instruments is described in the table below. In addition, military versions of the PAL16XXA/A-2 are available, with TIBPAL-15 Series and TIFPLA839/840 soon to come.

TI's Broad PAL/FPLA Family

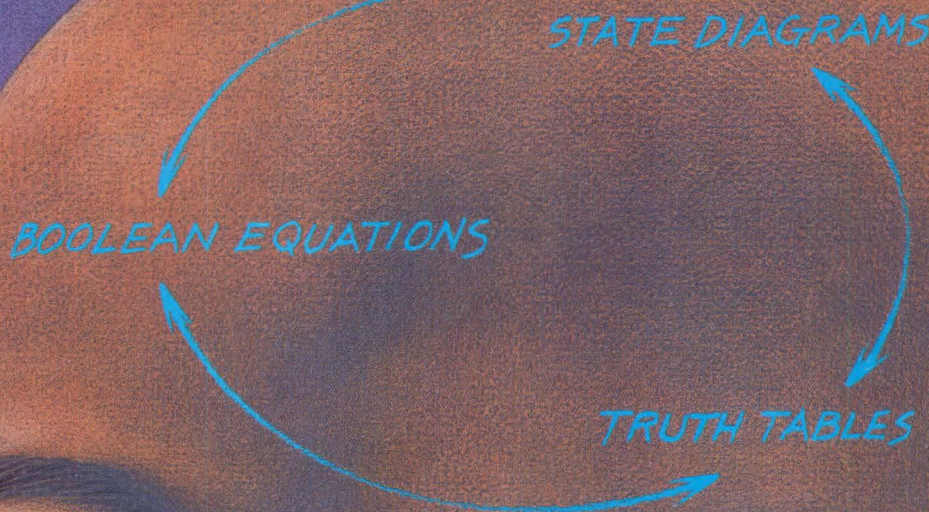
	$t_{pd(max)}$ (ns)	$I_{CC(max)}$ (mA)	Registered Outputs
PAL ICs			
TIBPAL16L8-15	15	180	0
TIBPAL16R8-15	15	180	8
TIBPAL16R6-15	15	180	6
TIBPAL16R4-15	15	180	4
PAL16L8A/A-2	25/35	180/90	0
PAL16R8A/A-2	25/35	180/90	8
PAL16R6A/A-2	25/35	180/90	6
PAL16R4A/A-2	25/35	180/90	4
FPLAs			
TIFPLA839	20	190	0
TIFPLA840	25	190	0

For more information on Texas Instruments PAL ICs and FPLAs, call your local TI distributor. To receive a data-sheet collection on all the new TI high-performance, user-programmable products, call Texas Instruments Incorporated at 1-800-232-3200 Ext. 201.

**TEXAS
INSTRUMENTS**

Creating useful products
and services for you.

YOUR MIND WAS OUR MODEL.



DATA I/O presents ABEL[™], the first logic design software built the ways you think.

Designing logic has never been easier.

ABEL is the revolutionary new CAE software package from Data I/O that lets you specify logic designs for IFL, PROM and PAL[®] devices using whatever method is most natural for you: state diagrams, Boolean equations, truth tables or any combination.

No more longhand conversions of truth tables to Boolean equations. No more longhand conversions from state diagrams to Boolean equations to Karnaugh maps. ABEL does it all.

Functional timesavers make design input easier.

ABEL's high-level language is filled with important timesavers. "Set" notation lets you group signals into sets and treat them as separate units in your design description. Free-format syntax lets you write designs without assigning particular elements to specified lines or column numbers. With macros and directives you can instruct the compiler to create blocks of text automatically. And with file inclusion you can merge an existing file with the source

file you're re-writing, avoiding redundant keystrokes.

Record-keeping is easy, too, because ABEL automatically produces comprehensive documentation including reduced equations, fuse-maps, labeled IC diagrams, production and service data, and test vectors.

Logic reduction expands your flexibility.

By using a powerful logic reduction algorithm, ABEL helps you easily reduce design descriptions down to their simplest, most efficient forms. Even preliminary designs can be quickly reduced. And by reducing the number of gates required to implement your design, ABEL also helps reduce the cost of related hardware.

Interactive testing verifies functional operation.

ABEL's interactive design and simulation, or "design loop," lets you create part of a design, write test vectors, and test the design by simulation. So now you can create and test new design ideas simultaneously and debug your designs as they evolve.

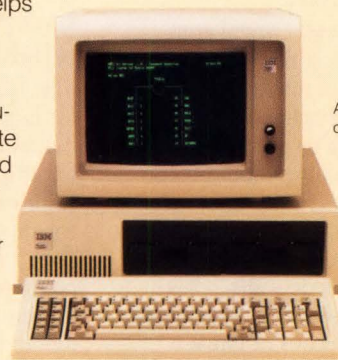
Works with your IBM[®] PC or Digital VAX[™].

Data I/O's ABEL software works

with your IBM PC (MS[™]-DOS operating system) or Digital VAX[™] (using VMS[™] or UNIX[™]). Other versions are on the way. ABEL contains a PALASM-to-ABEL converter for your existing PALASM files. And ABEL is compatible with any programmer supporting JEDEC standard fuse maps, including Data I/O's Programmable Logic Development System which handles more than 90 different logic devices.

Call toll-free 1-800-426-1045 and order ABEL today.

Enjoy the full potential of programmable logic by designing the way you think. Call today for more information or to place your order. Allow 6 weeks for delivery.



ABEL is a trademark of Data I/O Corporation; MS-DOS of Microsoft Corporation; VAX and VMS of Digital Equipment Corporation; UNIX of AT&T Technologies, Inc. PAL is a registered trademark of Monolithic Memories, Inc. and DEC of Digital Equipment Corporation.

Data I/O Corporation, 10525 Willows Road N.E., P.O. Box 97046, Redmond, WA 98073-9746. For immediate action, contact us directly. **CALL TOLL FREE:** 1-800-426-1045. In Washington, Alaska and Hawaii, call 206-881-6444. Europe: Vondelstraat 50-52, 1054 GE, Amsterdam, The Netherlands, Tel: (20) 186855. Germany GmbH: Bahnhofstrasse 3, D-6453 Seligenstadt, West Germany, Tel: (6182) 3088. Japan: Ginza Orient Building 6-F, 8-9-13, Ginza Chuo-ku, Tokyo 104, Japan, Tel: (03) 574-0211.

NEWSFRONT

Smart interface standard anticipates needs of future minicomputers

Scheduled for introduction this week, the Intelligent Peripheral Interface raises data transfer rates for big, fast computers.

While the industry has been focusing its attention on microcomputers, the American National Standards Committee has been working on an interface standard that anticipates the power, speed, and intelligence of tomorrow's powerful minicomputers and mainframes. The Intelligent Peripheral Interface (IPI), to be formally described at this week's Wescon '84, already has the backing of dozens of manufacturers throughout the electronics industry.

On its most basic level, the IPI—conceived by ANSC's X3T9.3 subcommittee—lays down a migration path for 8- and 14-in. Winchester disk drives. More dramatically, it acts as a precursor of computer architectures of the next 10 years, systems in which mass-storage peripherals will actually manage data for their hosts.

The transfer rate of the IPI differs sharply from that set forth by the Storage Module

Device (SMD), now the mainstay of high-capacity Winchesters. The basic SMD standard spells out a rate of 1.2 Mbytes/s, which some designers have enhanced to 1.92 Mbytes/s, and a cable stretch of about 50 ft. In contrast, the IPI specifies a transfer rate of 10 Mbytes/s over more than 400 ft of cable.

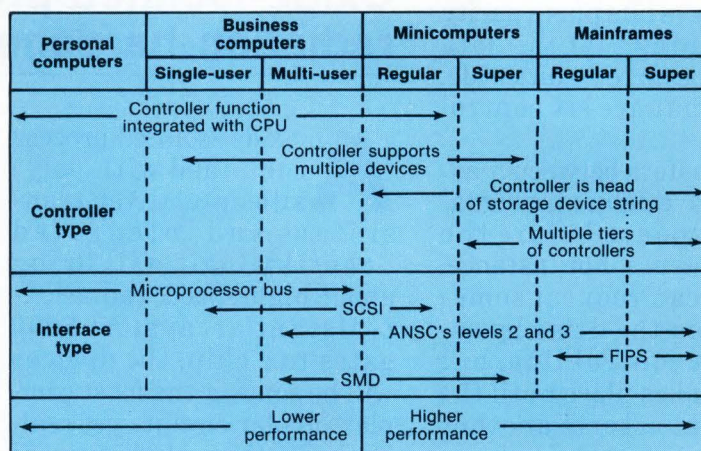
The SMD is not the only standard being threatened by the IPI. The latter will likely be the logical successor to the

Federal Information Processing Standard (FIPS), the interface currently employed for disk drives on IBM mainframes and a number of minicomputers.

The Small Computer Systems Interface (SCSI) stands a better chance of surviving the arrival of the IPI. Though both standards define similar functions and fulfill many of the same purposes, the SCSI is geared for multiple-user microcomputers and the IPI is intended for larger high-performance computing systems (Fig. 1).

Split-level model

The IPI is a four-level standard similar in concept to the International Standards Organization's Open Systems Interconnection model for local networks. At the high end of the IPI model is level 3, which supplies the intelligence by describing the



1. The Intelligent Peripheral Interface is intended for high-performance computers and data processors and may well replace the SMD and FIPS interfaces. IPI off-loads data storage management tasks from the host, much as the SCSI does for multi-user microcomputers.

Stephan Ohr

NEWSFRONT

command structure through which the host addresses logical blocks of memory. Level 2 defines the data exchange procedures for specific devices, and level 1 spells out the various bus protocols and logic states encountered during transfers. Level 0 specifies the physical connection between the host and its attached peripherals (Fig. 2).

Standard commands

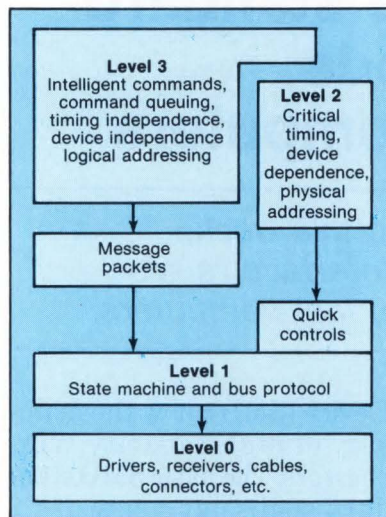
The standard's four types of host commands deal with control, positioning (requesting some physical motion from the attached drive), data transfers, and diagnostics. The transfer commands include Read, Write, and Copy. The last is a form of combination command: While one peripheral is responding to a read command, the other is tackling a write.

In essence, the IPI is designed for the master-slave relationship between a host computer and its peripherals. It calls for two parallel 9-bit data buses (8 bits plus a parity bit), meaning that the data path can be up to 16 bits wide. Beyond that are six control lines.

All transfers between master and slave demand a signal and a response before the transfer occurs. For instance, the host can request something from the drive by asserting a control line, but nothing takes place until the peripheral asserts another line in response.

The high-performance interface standard will necessitate cooperation from manufacturers of disk drives,

controller boards, semiconductors, and even cables and connectors. The list of advocates is growing steadily. Al-



2. IPI is a multilevel specification that resembles the ISO's OSI. Level 3 sets up the intelligent command structure, and level 2 spells out the device-specific addressing structure, which transfers data at up to 10 Mbytes/s. Levels 1 and 0 describe the hardware activity.

ready computer builders like NCR and Sperry and drive makers like Ampex, Century Data Systems, and Fujitsu have agreed to lend their support.

In addition, an endorsement is expected from Control Data, which until recently maintained observer status on the IPI committee. As for controller manufacturers, Xylogics leads the list, and AMP and Amphenol are prepared to design connectors for the specification.

Building the interface itself will require a collection of specialized hardware—processors and controllers, logic state machines, high-speed line drivers and receivers, and shielded cables and connectors. No doubt, assembling all those pieces into one cohesive unit that can perform the necessary handshaking and transfer data at 10 Mbytes/s will take a few years.

Oxide-isolated process yields radiation-hardened arrays

An oxide-isolated process combined with polysilicon-emitter transistors and integrated Schottky logic will bring about high-speed, radiation-resistant arrays. At 5000 gates to a chip, the devices will be some of the most complex bipolar circuits yet realized. Further, their typical loaded-gate delays of 1.2 ns—at a power consumption of just 120 μ W a gate—will rival those of high-speed CMOS

arrays.

Additionally, gates can be selectively sped up by using a resistor connection option in the CAD system to cut gate delays to just 0.9 ns. If the speed is enhanced, though, power consumption doubles. The approach, just now coming out of development at Raytheon Corp. (Mountain View, Calif.), goes with 2- μ m design rules.

The judicious choice of the thickness of the epitaxial lay-

It's the new AD650 from Analog Devices—the first and only monolithic IC V/F converter to deliver 0.1% max nonlinearity at 1 MHz full scale frequency. But that's just the beginning. The AD650's performance advantage extends to lower full scale frequencies, too. At 10 KHz, for example, it provides 14-bit linearity. And it stays linear to 12 bits even when you get to 100 KHz.

Which means that for A/D conversion, the AD650 lets you optimize linearity, resolution or conversion rate to meet your exact system requirements. What's more, the inherently monotonic transfer function of a V/F gives you an A/D with no missing codes.

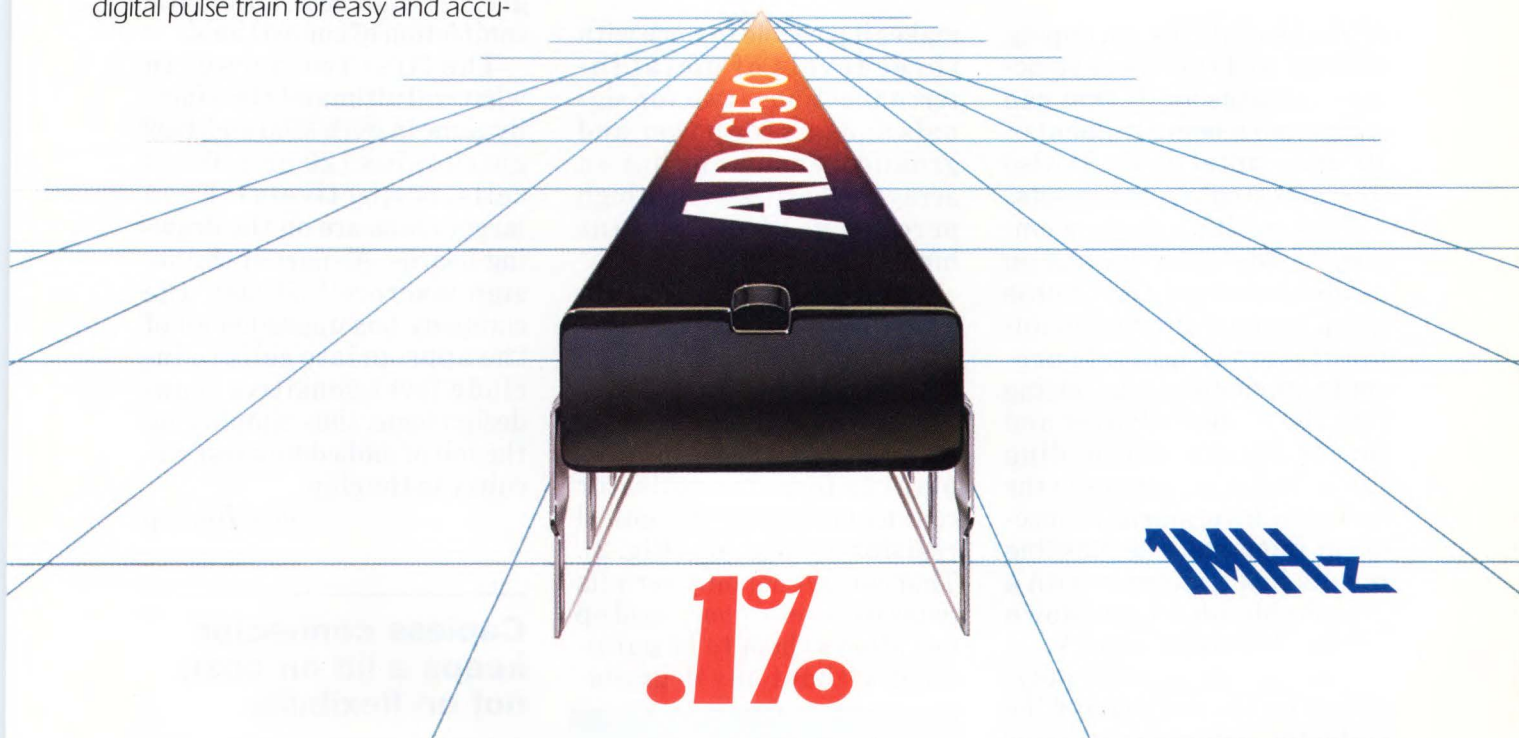
And of course, a superlinear V/F can convert an analog signal to a digital pulse train for easy and accu-

rate transmission across an isolation barrier. The AD650 can serve as both a transmitter in V/F mode and as a direct or phase-locked loop type F/V-based receiver.

The AD650's versatile architecture accepts unipolar or bipolar input in the form of either current or voltage. And only the AD650 provides separate analog and digital grounds so you can keep 1 MHz output pulses and other digital noise out of the analog signal path.

Best of all, the AD650 is very competitively priced—it starts at just \$7.15 in thousands.

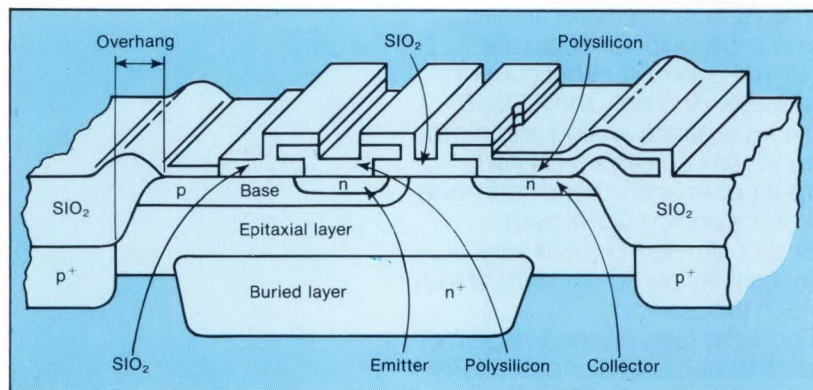
For all the facts on the V/F performance leader, just call Applications Engineering at (617) 935-5565 or write Analog Devices, Inc., P.O. Box 280, Norwood, MA 02062.



At 1 MHz Only One V/F Converter Guarantees This Linearity.

Analog Devices, Inc., Two Technology Way, Norwood, MA 02062; Headquarters: (617) 329-4700; California: (714) 641-9391, (619) 268-4621, (408) 947-0633; Illinois: (312) 653-5000; New York: (716) 425-4101, (315) 437-5277; Ohio: (614) 764-8795; Pennsylvania: (215) 643-7790; Texas: (214) 231-5094, (713) 664-6704; Washington: (206) 251-9550; Belgium: (3) 237 48 03; Denmark: (2) 845800; France: (1) 687-34-11; Holland: (1620) 51080; Israel: (052) 28995; Italy: (2) 6883831, (2) 6883832, (2) 6883833; Japan: (3) 263-6826; Sweden: (8) 282740; Switzerland: (22) 31 57 60; United Kingdom: (01) 9410466; West Germany: (89) 570050

NEWSFRONT



1. The overhanging regions of silicon-dioxide act as a mask to prevent implanted impurities from reaching the buried n^+ layer. That helps keep the transistor breakdown voltage high.

er, depth of diffusion, doping profiles, and transistor structures creates an IC that can withstand a bombardment of 10^6 rads (total dose). It also tolerates single-event upsets.

The circuit's structure employs a sidewall oxide and an oxide overhang that helps mask regions during ion implantation (Fig. 1). It prevents impurities from getting into the n^+ buried layer and into the areas surrounding the p^+ isolation regions in the epitaxial layer during subsequent implants. The masking results in a transistor with a reasonably high breakdown voltage, between 5 and 8 V.

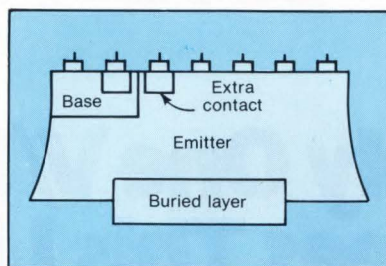
Further, going with polysilicon for the emitter and the collector reduces transistor parasitics, in turn permitting processing to be handled at lower temperatures. Thus junction depths can be better controlled and higher f_T s can be realized than possible with transistors that do not take the polysilicon path.

The oxide that forms the overhang is grown at a low temperature, yielding an almost planar surface. That

makes it possible to work with three levels of metal interconnections (two for signals and one for power and ground), ensuring that an array can harness a very high percentage of its gates (as high as 85%).

Adds an extra implant

The approach, compared with a conventional integrated Schottky logic structure, adds an extra n^+ implant to form the collector contact needed for the optical resistor connection (Fig. 2). That contact not only permits gates to be selectively sped up but allows them to be paralleled without any degrada-



2. An additional collector contact region furnishes a point to tie in a resistor that cuts gate delays from 1.2 ns to just 0.9 ns. If the resistor is used, a gate's power consumption doubles to 240 μ W.

tion in performance. Basically, the cell structure is similar to the company's previous junction-isolated integrated Schottky logic arrays, comprising a single input and a quad output gate.

The collector contacts also can serve as cathode connections for remote fan-out diodes. These can be used to relieve wiring track congestion and thus improve routing. So far, sample circuits have been implemented that exhibit greater than 95% automatic completion of connections.

The first two arrays in what will ultimately be a family come in with 3500 and 4992 gates (plus 120 or 150 I/O cells, respectively). Even larger chips are on the drawing boards. As part of the design macrocell library, the company has upgraded all of the appropriate cells to include level-sensitive scan-design logic, thus simplifying the job of embedding test circuitry in the chip.

Dave Bursky

Capless connector keeps a lid on cost, not on flexibility

A single-piece connector that works with insulation-displacement and crimp-type joints eliminates the hinged lid that normally serves as a protective cap for such junctures. The part thus lowers the costs typically associated with both connections.

What's more, the connec-

IV-1611

2 Megabyte RAM Board

- 68020 compatible (32, 16, 8 bit transfers)
- 4-way internal interleave

VMExcellenceTM

VMEbus

UNIX System V*

High Resolution
Color Graphics

Ironics VMEbus boards, systems, and software provide the OEM and Systems Integrator with a powerful and productive development environment, a high performance, cost effective target environment, and the tools and technical support to put it all together... from *IRONICS*, the price/performance leader in VMEbus.

*Trademark AT&T Bell Laboratories.



IRONICS Incorporated

Computer Systems Division

742 Cascadilla Street

Ithaca, N.Y. 14850

607-277-4060 Telex: 705-742

CIRCLE 25

NEWSFRONT

tor's pins are arranged in single rows, allowing them to be stacked to form different-sized parts. And harnesses with varying wire lengths pose no problem to the unit.

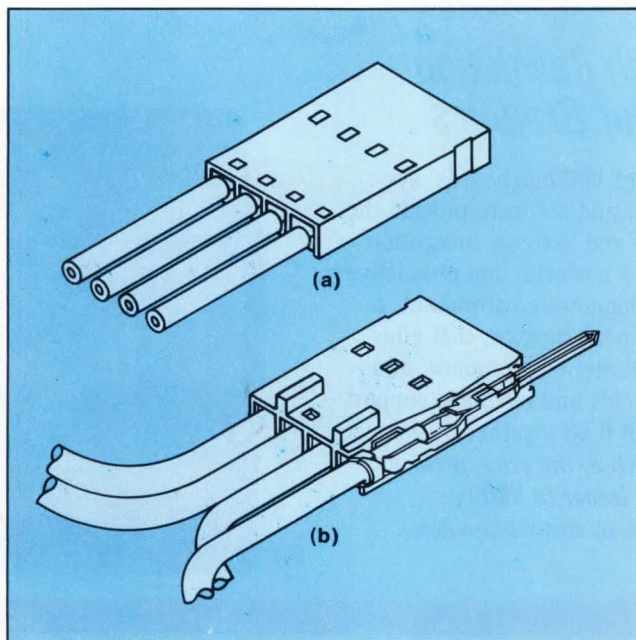
The actual technique employed to join wires to the contacts of the C-Grid SL package from Molex Inc. (Lisle, Ill.), does not differ from that used in insulation displacement. Once the wire has been attached, the contact point is pushed inside the protective plastic housing, shifting the pins or pin receptacles into position (see the figure). Normally, a hinged lid closes over the contacts.

This essential difference means that automated connection equipment must be altered to handle these parts, since existing machinery is

not designed to push in the contacts. Additionally, the equipment must break off the metal carrier strip that holds the contacts in place. In a typical connector, the contacts are inside the housing, so the support strip is not needed.

Allows for stacking

As mentioned, the part's pins are set up in single rows, which allows them to be stacked. A number of connectors can also be grouped together to create a larger piece. That is particularly helpful in harnesses that employ different-length wires coming to a single connector. Instead of manually connecting each wire, as is now required, a manufacturer can automatically tie all wires of one length



The single-piece connector, from Molex, has one row of contacts (a). Wires are inserted as they are with the insulation-displacement process. The contacts are then pushed into the housing, causing the pins to emerge (b) and moving the wire inside the protective casing.

PMI North American District Sales Offices

Boston, Massachusetts
(617) 655-8900

Chicago, Illinois
(312) 885-8440
(800) 323-8755

Dallas, Texas
(214) 341-1742
(800) 223-6147

Los Angeles, California
(714) 666-0140

Philadelphia, Pennsylvania
(215) 639-9595

Santa Clara, California
(408) 727-6616

PMI North American Authorized Distributors

Anthem Electronics
Bell Industries
Future Electronics
Gerber Electronics
Hall-Mark Electronics
Intek Electronics Ltd.
Merit Electronics Corp.
Pioneer Electronics
Semi Dice Inc.
Zentronics

Over 90 locations in
North America.





PRECISION At Precision Monolithics, only three things count: precision, precision, and precision.

We believe quality control isn't just the last step before shipping. It's the last, the first, and every step in between.

If you already specify our

analog ICs, precision is part of your philosophy. But for us, it's even more.

It's our name.

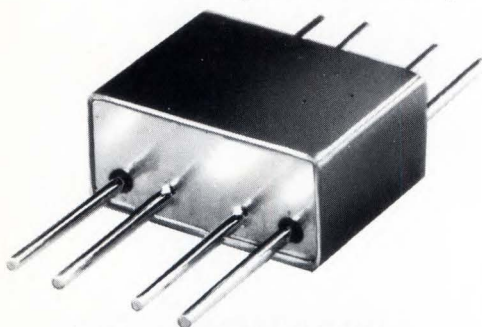
Precision Monolithics Inc.
1500 Space Park Drive, Santa Clara, California 95050, USA.

A Bourns Company.



flat pack mixers

(+7 dBm LO)



5 to 1000 MHz
only \$14⁹⁵ (6-24)

IN STOCK...IMMEDIATE DELIVERY

- pin-for-pin replacement of competitive models
- **MIL-M-28837/1A performance***
- extra-rugged construction
- hermetically-sealed
- every unit thermal shock tested, 5 cycles, -54°C to +100°C
- low conversion loss, 6.2dB
- hi isolation, 40dB
- 1 year guarantee

*units are not QPL listed

LMX-113 SPECIFICATIONS

FREQUENCY RANGE, (MHz)

LO, RF 5-1000
IF DC-1000

CONVERSION LOSS, dB	TYP.	MAX.
one octave from band edge	6.2	7.0
total range	7.0	8.0

ISOLATION, dB	TYP.	MIN.
5-50 MHz LO-RF	50	45
LO-IF	45	40
50-500 MHz LO-RF	40	30
LO-IF	35	25
500-1000 MHz LO-RF	30	20
LO-IF	25	17

SIGNAL 1dB Compression Level 0dBm min

finding new ways...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
2625 E. 14th St. B'klyn, N.Y. 11235 (718) 769-0200

C91-3 REV. ORIG.

CIRCLE 26

TECHNOLOGY NEWS

NEWSFRONT

into a single grouping. Small plastic strips hold a number of such groups together so that they can be handled as a single entity.

The SL family accepts 24-30 gauge wire for insulation-displacement connections and 22-36 gauge in crimping applications. In both, standard 0.100-in. centers are used.

Terry Costlow

Superminis adopt Unix variation, with no performance loss

For the first time, Unix has been adapted to a superminicomputer environment—without the 30% to 50% degradation that is normally associated with adapting an operating system to a different class or type of computer.

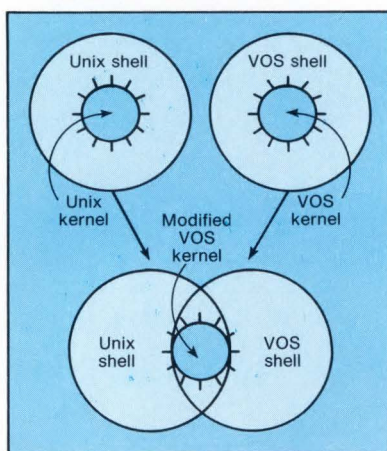
By modifying the kernel of its proprietary Virtual Oper-

ating System (VOS) and combining it with the VOS and Unix System V shells, Harris Corp.'s Computer Systems Division (Fort Lauderdale, Fla.) plans to give users the best of both operating systems concurrently: the higher throughput of VOS and the easy programming and broad application base of Unix.

Called VUE (for VOS/Unix Environment), the software consists of the VOS kernel, which schedules tasks, allocates memory, and handles communication, and of both the VOS and Unix System V shell functions. The resulting hybrid is an operating system that looks and acts like System V; it now handles some Unix system calls and will eventually respond to all Unix commands and calls. In addition, since the VOS shell is left virtually intact (see the figure), programs written for VOS also can run on the superminicomputer.

Harris is developing the operating system in three phases: first a C compiler, next initial application and system calls, and finally the balance of the commands and systems calls. The C compiler, completed earlier this year, contains a special I/O library that accommodates Unix's byte stream and VOS's faster record manipulation. In the second phase, to be finished by the end of the year, the VOS kernel will be modified to support many Unix utilities. The balance of utilities and calls will be added sometime next year, bringing VOS and Unix up to full speed.

Heather Bryce



By surrounding the modified kernel of its Virtual Operating System with both a Unix and a VOS shell, Harris can give its superminicomputer users high throughput and a broad application base.



Photographed at Gulfstream Aerospace, Savannah, GA.

Is your calculator programmed for success?

Move up to the TI-66. The easy 512 step programmable.

You're in the fast lane now, and the last thing you need is a calculator that slows you down. That's why you need the TI-66 programmable calculator

from Texas Instruments. The TI-66 offers full programming power and flexibility so you can handle complex and repetitive math problems quickly, easily, and with fewer keystrokes.

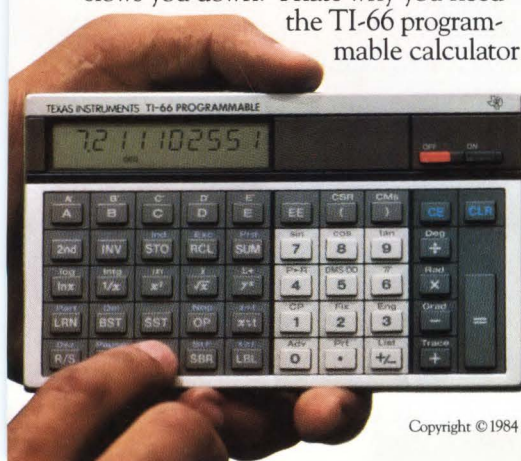
Its 512 merged program steps and over 170 built-in scientific, engineering, and statistical functions make for powerful programming. And its sleek, streamlined design makes for easy use.

Its Algebraic Operating System lets you key in problems as they are written, left to right. And its 10-digit angled Liquid Crystal Display not only makes it easy on your eyes, but provides alphanumeric notation of

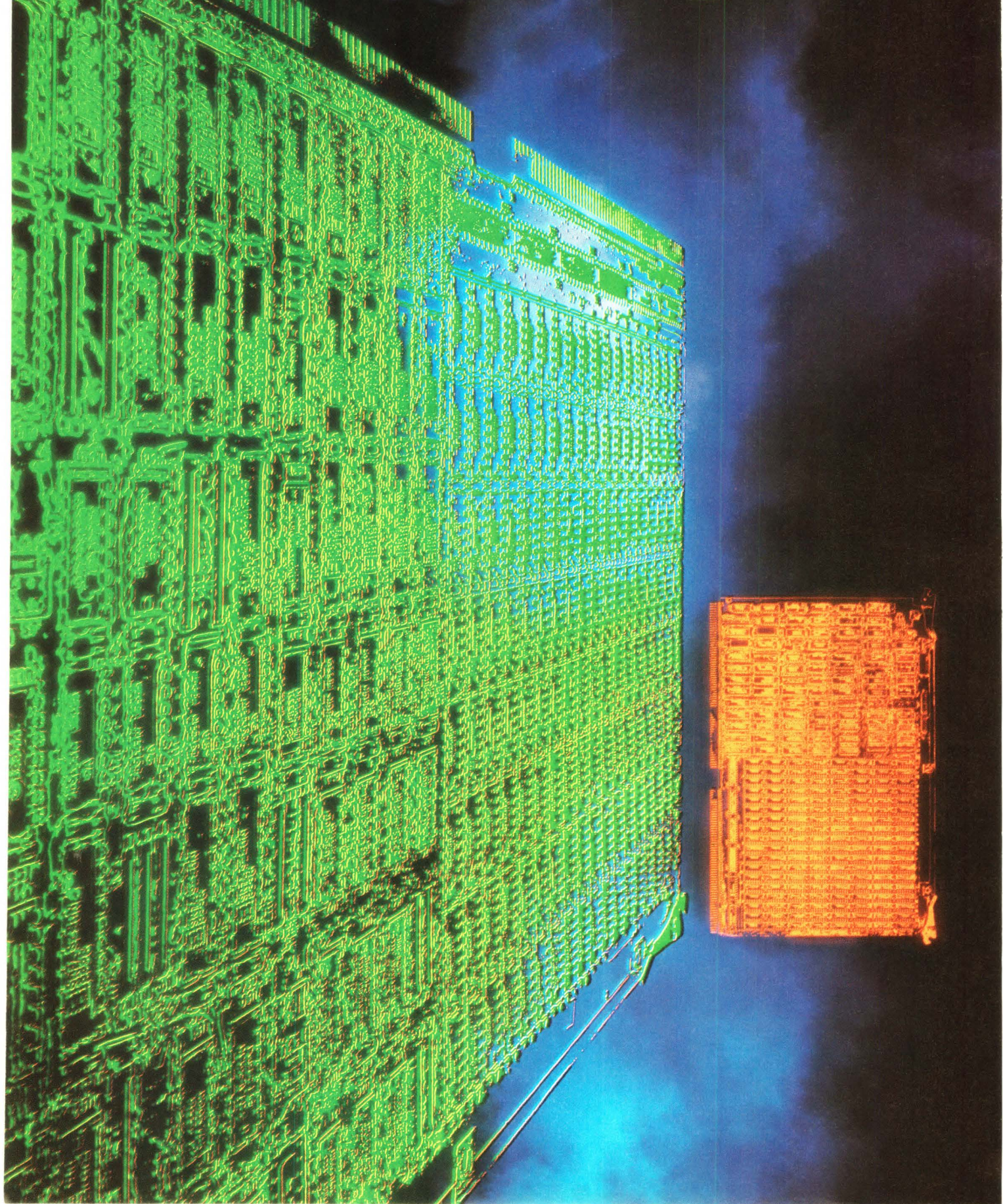
your program steps so you can make easy modifications as you go along.

The keys are readable and large enough for your fingers. The guide book is a quick study. And at \$69.95 suggested retail, the price is easy. So instead of spending extra time on routine calculations that won't get you noticed, promote yourself with the TI-66 programmable calculator.

TEXAS
INSTRUMENTS
Creating useful products and services for you.



MOTOROLA

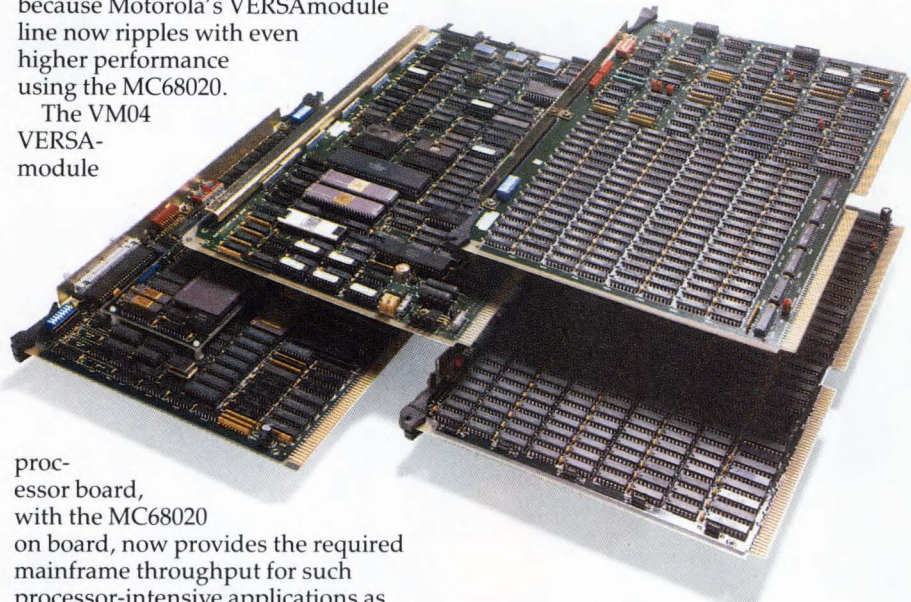


Challenge the mainframes.

VERSAmodule[™] now run the MC68020,
true 32-bit performance standard.

VERSAmodule microcomputer boards have already proven themselves in performance-demanding communication, industrial, laboratory and imaging applications. You knew these boards were powerful workhorses before, but hold on to your bootstraps, because Motorola's VERSAmodule line now ripples with even higher performance using the MC68020.

The VM04
VERSA-
module



processor board, with the MC68020 on board, now provides the required mainframe throughput for such processor-intensive applications as bit-mapped graphics manipulators, scientific data acquisition systems and artificial intelligence machines. Applications that, before this, required mainframe machines.

Gaining speed, adding power, lowering overhead.

The new VERSAmodule VM04 processor board can access more than 4 billion bytes of data and manipulate or process 32 individual pieces of information every 180 billionths of a second (180 nanoseconds). Measured in millions of instructions per second (MIPS), the VM04 operates at a sustained rate of 2 to 3 MIPS, with burst rates exceeding eight MIPS, challenging the speed of some mainframe computers.

16K bytes of instruction/data cache on-board help reduce off-board memory accesses to ensure top performance. When off-board access is needed, the VM04 calls on the interface capabilities of Motorola's MC68020-specific RAMbus[™] to eliminate most arbitration overhead and speed memory transfers.

The VM04 monoboard is the first MC68020 processor board to offer paged memory management hardware, plus an interface to support

the soon available MC68881 floating point math co-processor.

These new modules add to a broad offering of board-level products including processor, memory, controller and communication modules with complete evaluation and development systems.

Broad VERSAmodule line.

Two new high density memory boards have been added to the line to complement the MC68020-based monoboard.

The VM12 includes 1 or 4 Mbytes of RAM and supports the full 32-bit address width of the M68000 Family.

The VM13 dynamic RAM module provides 1 or 4 Mbytes of random access memory dual ported to both RAMbus[™] and VERSAbus[™]. A perfect system mate for the VM04 32-bit monoboard, the VM13 has error detection and diagnostic capability.

For system applications requiring high-capacity rotating mass storage,

the VM22 disk controller supports four SMD drives and four SA 400/800 floppy disk drives. Data transfer speeds up to 3 Mbytes/sec are maintained by the direct memory access feature of the disk controller.

A choice of real-time and whose-time-has-come operating systems.

The VERSAmodule Family is supported by both of Motorola's M68000 operating systems: the VERSAdos[™] operating system for real-time applications, and the SYSTEM V/68[™] operating system where a UNIX[™] operating system environment is desired.

Full operating system support, including VERSAdos real-time device drivers, is available today for MC68000- and MC68010-based VERSAmodule monoboards. Porting is under way to assure their early availability on the VM04 monoboard.

Continued Motorola support.

Add to all this Motorola's expertise, proven products, training and service support and you can understand why VERSAmodule continue to be your best high-performance choice for board-level applications.

For more detailed information on VERSAmodule system components, mail in the coupon or call your local Motorola semiconductor sales office, authorized systems distributor or systems representative.

We're
on your
design-in
team.



MOTOROLA

VERSAmodule, VERSAbus, VERSAdos, SYSTEM V/68 and RAMbus are trademarks of Motorola Inc. UNIX is a trademark of AT&T Bell Laboratories.

To: Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036
Please send me more information on the VERSAmodule system.

VERSAmodule



Name

Title

Company

Address

City

State

Zip

Call Me ()

206ED103184

Gould AML... Innovation and Quality in Semiconductors

The double-metal answer to sluggish gate arrays.

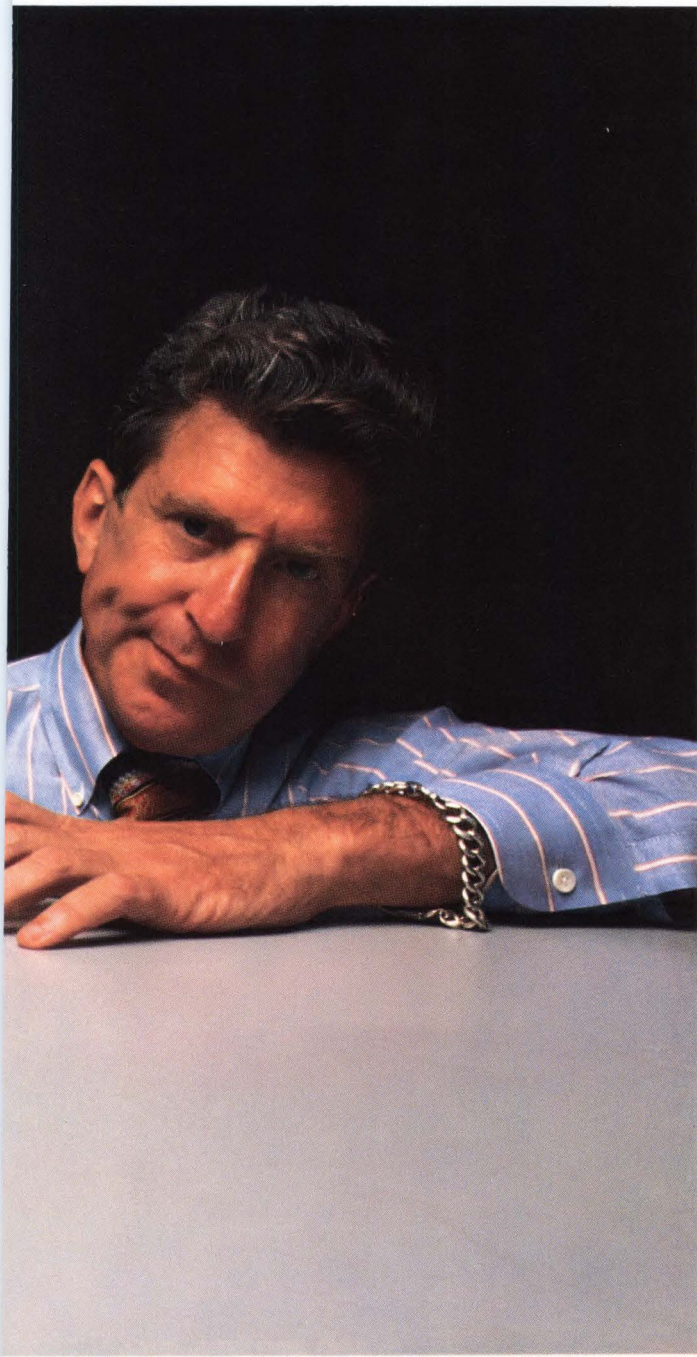


What are you waiting for? Move into the world of 1 to 3 ns gate delays.

Gould AMI 3μ double-metal HCMOS technology opens up applications once considered too fast for CMOS gate arrays. Now, you can have low cost and power consumption without giving up speed.

Fast circuit design and delivery.

These double-metal arrays don't just work faster—they're designed faster. One reason is



Gould AMI's growing library of macro cells. Over 100 popular functions—predefined and pretested—allow you to avoid wasting time and money reinventing the wheel.

Also, Gould AMI's fully integrated CAD software places and routes each programmable level automatically. More than fast, it can utilize over 98% of available gates!

Gould AMI offers 3μ double-metal arrays from 1100 to 4000 gates. (Later this year, our 2μ family will provide up to 10,000 gates.) Delivery in production quantities takes just 5 to 7 weeks from prototype approval.

Service just as fast and flexible.

We can do everything from design through fabrication—or any part of the job you wish. Gould AMI CAD software runs on Prime® and VAX™ computers. Our macro cells are available on major workstations. We can train your designers. And there's second sourcing, of course.

You're invited to find out more about the Gould AMI gate array program. Call us at 408-554-2311, or return the coupon. Because if the job is making CMOS gate arrays faster, Gould AMI is right for the job.

Prime® is a registered trademark of Prime Computer, Inc.
VAX™ is a trademark of Digital Equipment Corporation.

Yes, I want faster gate arrays—fast!
Tell me all about Gould AMI's:

- | | |
|---|--|
| ☐ Complete gate array line. | ☐ Macro cell libraries. |
| ☐ Complete standard cell line. | ☐ CAD training program. |
| ☐ CAD software programs. | ☐ Send your enlightening case history, "Gate Arrays—The Hidden Cost Savings." |

Name _____

Title _____

Company _____

M/S _____

Address _____

City/State/Zip
() _____

Phone No: _____

Mail to: Gould AMI Semiconductors
Gate Arrays Marketing
ED 10-31 3800 Homestead Road
Santa Clara, CA 95051



GOULD

AMI Semiconductors

WORLD'S LOWEST PROFILE, FULLY SEALED BINARY CODED SWITCH

New Switch Saves Space.

However you look at it, EECO's new Series 3300 MICRO-DIP® switch is the lowest profile binary-coded rotary switch in the world. An incredible .190 inches high, and only .390 inches square, the new switch allows a compact board architecture never before possible with conventional rocker or rotary switches.

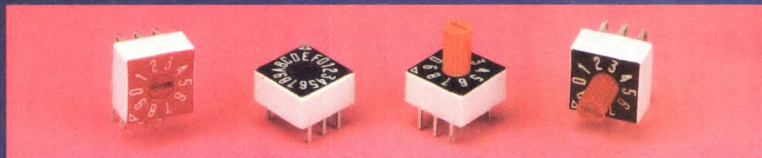
Fully Sealed. We've completely and permanently sealed the new MICRO-DIP switch top and bottom to be impervious to automatic wave solder and cleaning processes. The switch withstands the stringent Fluorinert* leak test for board-mounted components. The O-ring top and epoxy-sealed bottom are standard.

Easy-to-Set. Programming electronic equipment was never easier. Our screwdriver-slot and extended shaft actuators make setting binary values a one-step operation. No need to fumble with multiple rocker or slide actuators, no need to convert from one number system to another. Simply dial in the value you need. Positive detent actuation lets you know your setting is securely entered.

From the MICRO-DIP Originators. Our new switch incorporates all the special design features you've come to expect from EECO. Like gold plated contacts, operational longevity, rugged construction, and generous environmental/electrical operating ranges. And all at an affordable price. At EECO we profile our products for tomorrow's technology. Call us or our nearest representative for more information. EECO Incorporated, 1601 East Chestnut Avenue, P.O. Box 659, Santa Ana, CA 92702-0659, Phone: (714) 835-6000; EECO Ltd., Bar Hill, Cambridge, CB3 8SQ, England, Phone: Crafts Hill (0) 954-80257.

* Fluorinert is a registered trademark of 3M Corporation.

CIRCLE 27



EECO®

CONFERENCE PREVIEW

High efficiency will be the target at first photovoltaic conference

Cost per watt is the bottom line as nonsilicon and stacked photovoltaic cells vie with traditional techniques.

Efficiency and relative low cost are the underlying goals of much of the research activity in photovoltaic materials. Crystalline silicon is currently the most popular material, although amorphous silicon and even nonsilicon substances like gallium arsenide and indium phosphide are rising to the forefront as well. Advances in these areas will be the subjects discussed at the first Photovoltaic Science and Engineering Conference in Kobe, Japan, Nov. 13-16.

Crystalline silicon has traditionally been the material of choice for photovoltaic cells because of its high energy conversion efficiency, although it is costly to produce and somewhat limited in maximum size. Advances in crystalline silicon may bring down cost while maintaining relatively high efficiency. Amorphous silicon shows even greater promise: Its efficiencies approach the theoretical limits, and the

material can be easily mass-produced. Even so, the brightest hope may come from non-silicon technologies—GaAs and InP cells using a stacked construction have already demonstrated record efficiencies.

New ways to cut costs

In an attempt to overcome high costs, researchers at the California Institute of Technology (Pasadena, Calif.) have constructed cells using relatively low-cost sheet silicon. Semiconductor techniques like ion implantation, annealing, diffusion, surface passivation, and antireflective coatings have yielded several sheet silicon cells with efficiency levels of about 13%. The theoretical efficiency limit for any type of silicon cell is 30%.

Though researchers predict that the efficiency of the sheet-silicon cells could be improved further, the IC-quality silicon and processing steps may preclude further cost reduction.

Amorphous silicon, on the

other hand, can be made inexpensively, since the production process involves "spraying" the material onto a ceramic substrate. Amorphous cells have efficiencies of about 6%, but many cells will soon boost that to as much as 13%. One such cell, developed by Siemens AG (West Germany), uses carbothermal reduction. That process combines high-purity carbon and silicon in an arc furnace to produce solar cells with efficiencies of 10%.

It's all in the structure

Large-sized amorphous cells (20 by 30 cm) with an active area of 90% and an efficiency of about 7% were developed by Fuji Electric Corp. (Yokosuka, Japan) using a glass substrate. A low-resistive tin oxide film forms a transparent top electrode. The active area of the cell is reduced by pin holes that form on the surface. To counteract this effect, a dipping method for photoresist coating has been employed.

New silane and silane-derivative gases, which are now being used in production spraying, are under study at the University of Tokyo. In the process silane gas is doped with the appropriate carrier, either boron (p dopant) or phosphorus (n dopant), and passed over the ceramic substrate to build up the n and p layers. The new gases, SiHF_3 and Si_2F_6 , are prepared by slow-discharge decomposition and give deposition rates

Curtis Panasuk

CONFERENCE PREVIEW

that are consistent with high-rate production. Cells with these gases show an efficiency of 8.3%.

Too hot!

Exposure of an amorphous solar cell to heat causes efficiency to drop and may eventually lead to complete destruction of the cell. Researchers at Kanegafuchi Chemical Co. (Kobe, Japan) discovered that heating an amorphous cell to 230°C for two hours can degrade efficiency by 60%. The degradation is due to carriers drifting in the cell.

The thermal instability of amorphous cells means that output cannot be boosted by concentrating sunlight from a large area onto the cell. On the other hand, many non-silicon photovoltaic cells can tolerate temperatures up to 100 times higher, making them suitable for this purpose. However, they are more difficult to manufacture and up to four times more costly than silicon.

Still, the ability of these cells to tolerate higher temperatures, combined with their 30% higher efficiencies, allows a lens to concentrate light from a large area onto a single cell, resulting in a cost per watt similar to that of the amorphous silicon cell.

Beyond silicon

One such nonsilicon cell, developed by researchers at Nippon Telegraph and Telephone Public Corp. (Tokai, Japan), is based on indium phosphide, which has a 1.34-eV band gap—ideal for

solar power conversion. A 17% conversion efficiency can be achieved using an n^+/p^- structure formed by thermal diffusion of selenium.

A new method of stacking nonsilicon cells might use AlGaAs as the top layer of a solar cell (see the figure). Being studied at Varian Associates Inc. (Palo Alto, Calif.), the top element of the structure would convert blue light into power with a 19% efficiency. Red light would pass down through the sandwich to an InGaAs layer, where it is converted with an 18% efficiency. If the two efficiencies were additive, this would give the cell a 37% efficiency. However, since the AlGaAs layer blocks some of the red light, the effective conversion efficiency is actually somewhat lower.

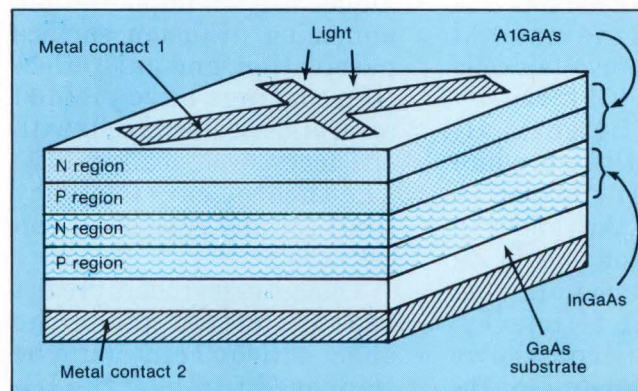
Although this stacked cell has not yet been constructed, researchers claim they have created the InGaAs lower layer and capped it with a material that simulates the light-absorption characteristics of an AlGaAs layer. With

this cap in place, the lower cell has an 11% efficiency; once the real AlGaAs layer is added, the stacked cell will probably yield a 30% efficiency.

Better voltage handling

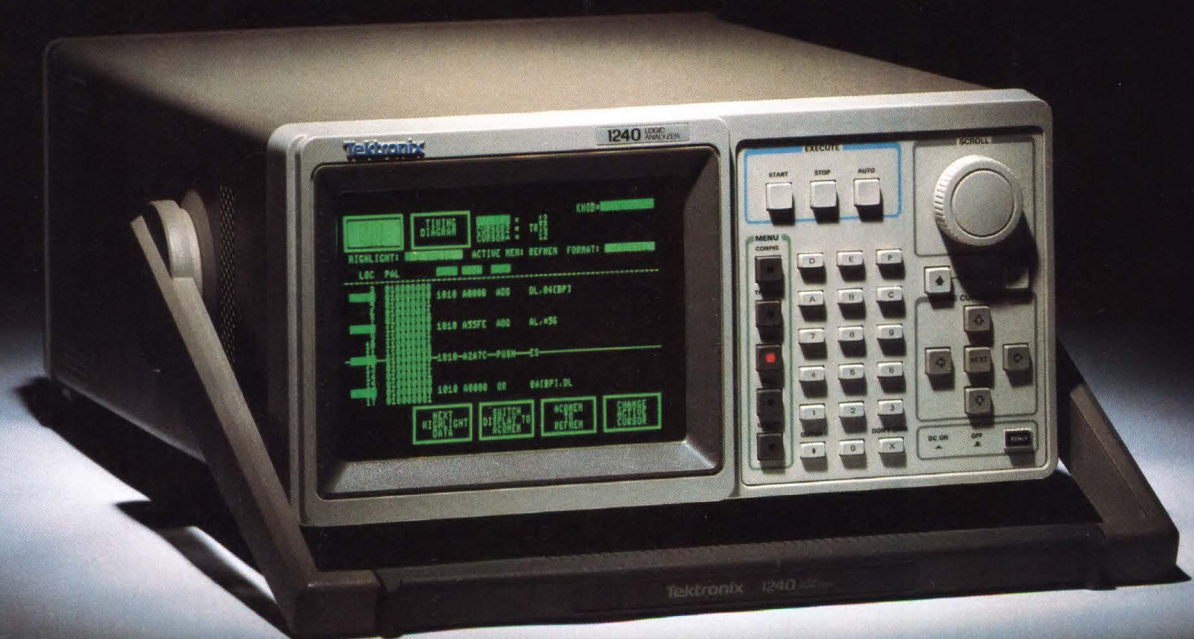
In addition to producing higher efficiencies, stacked cells can lead to higher voltage outputs because the two cells can be connected in series. With an output voltage of 1.1 V, the stacked cell might prove better for powering portable CMOS electronic devices than would the silicon cell, which only has an output of 0.6 V.

Another stacked cell, created by Hughes Aircraft Co.'s Hughes Laboratories (Malibu, Calif.), uses infinite-melt LPE (liquid phase epitaxy) techniques. The bottom cell is silicon and the top is a mechanically stacked gallium arsenide cell. With both the top and bottom cells working, Hughes reports a 17% efficiency, even though theoretical calculations predicted a 25% efficiency. □



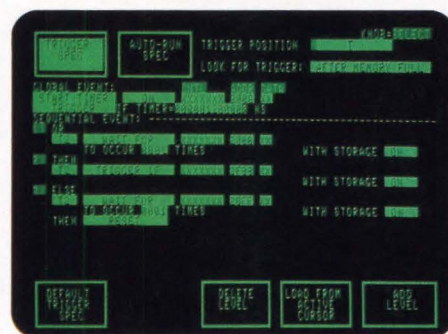
Stacking nonsilicon cells is a way of achieving record efficiencies in a small area. The InGaAs lower layer of the sandwich converts the light that the AlGaAs upper layer misses into electrical energy, giving 30% efficiencies.

IN BLACK AND WHITE: WHY THE TEK 1240 IS THE BEST OF THE LEADING LOGIC ANALYZERS.



Tektronix
COMMITTED TO EXCELLENCE

THE DIFFERENCE BETWEEN NIGHT AND DAY.



1 No other logic analyzer lets you clearly see what your hardware and software are doing at the same time.

Only a correlated dual timebase allows true interaction analysis. Only Tek has it.

As your digital designs become more complex and you subdivide your design, only the 1240 lets you obtain an accurate picture of real-time interactions between independently-clocked modules.

By defining triggers based on the data from both time bases, you can easily monitor the interaction between hardware and software or the relationship of two dual processors—with information displayed in a time-aligned manner:

Stark contrast to the jumble of data or jerry-built clocking by any other system of acquisition.



2 No other logic analyzer offers such complete performance analysis. For software. And for the entire system.

By combining its dual timebase with the high-resolution, 10ns timing you need to look at hardware events, the 1240 adds a new, more powerful dimension to performance analysis: complete systems analysis.

In software analysis alone, the 1240's multilevel trigger takes you well beyond the limited, continuous event analysis of other logic analyzers. Want to look at time spent in multiple interrupts during execution of a software module? Only the 1240 can measure,

compare and graph the event distributions.

3 Only the Tek 1240 offers so much triggering capability for both hardware and software analysis.

For software analysis, the 1240 combines 14 levels of conditional triggering with data flow and program flow qualification. You can pinpoint where your software went wrong right away. Without wading through mountains of data.

For hardware analysis, counters, timers and duration filters allow you to quickly locate problems that result from the time characteristics—as well as the state—of the hardware.

Moreover, only the 1240's dual timebase lets you combine all these capabilities to analyze the interaction of both hardware and software.

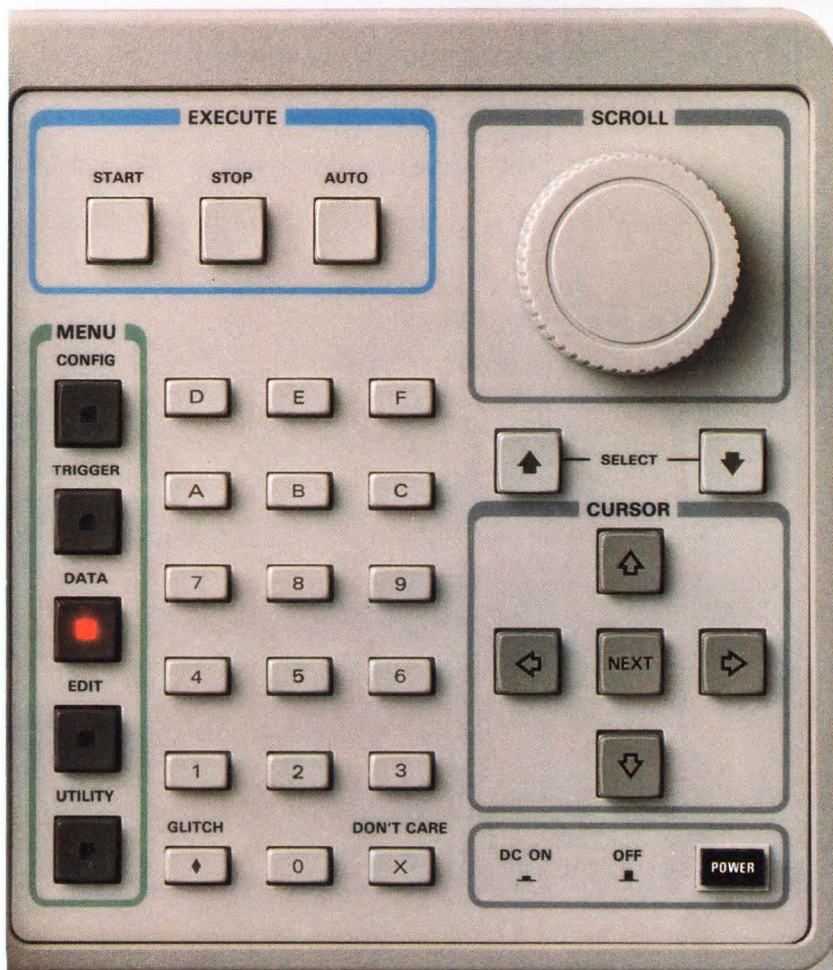


4 Every logic analyzer claims to be easy. Only the 1240 is as easy as you want it to be.

Easy is no bargain if it comes at the expense of performance. So the 1240 lets you select from four distinct levels of operation, adding more advanced features only as your design challenges require.

Other user conveniences are obvious at first glance: the unique touch display lets you select menu items without ever taking your eyes off the screen. Key-strokes are minimal and logical. And, proving that buttons aren't always the best answer, the smooth, flicker-free scrolling of the big front panel knob proves to be one of the 1240's most pleasing user features.

(Continued next page)



5 No other logic analyzer is as modular, expandable or versatile, to keep your costs low and compromises few.

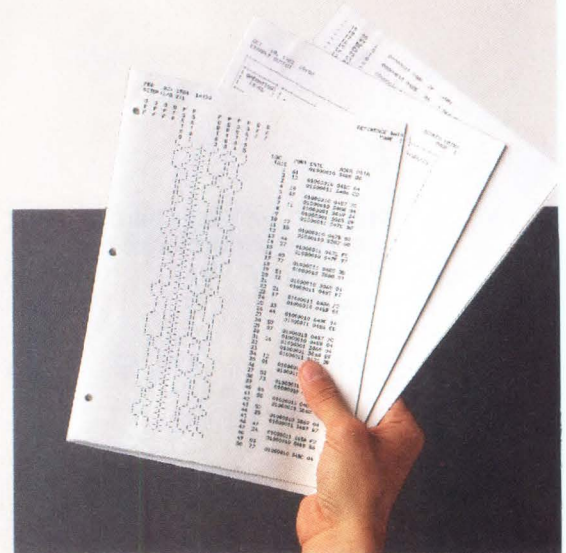
No competition here. The 1240 supports all major micro-processors. It includes three types of disassembly, so you can

for each application. You can add ROM Packs for data analysis; RAM Packs for data storage; COMM Packs for various RS-232 and GPIB communications environments, including a wide range of printer support; and a master/slave capability that



make the format fit the job.

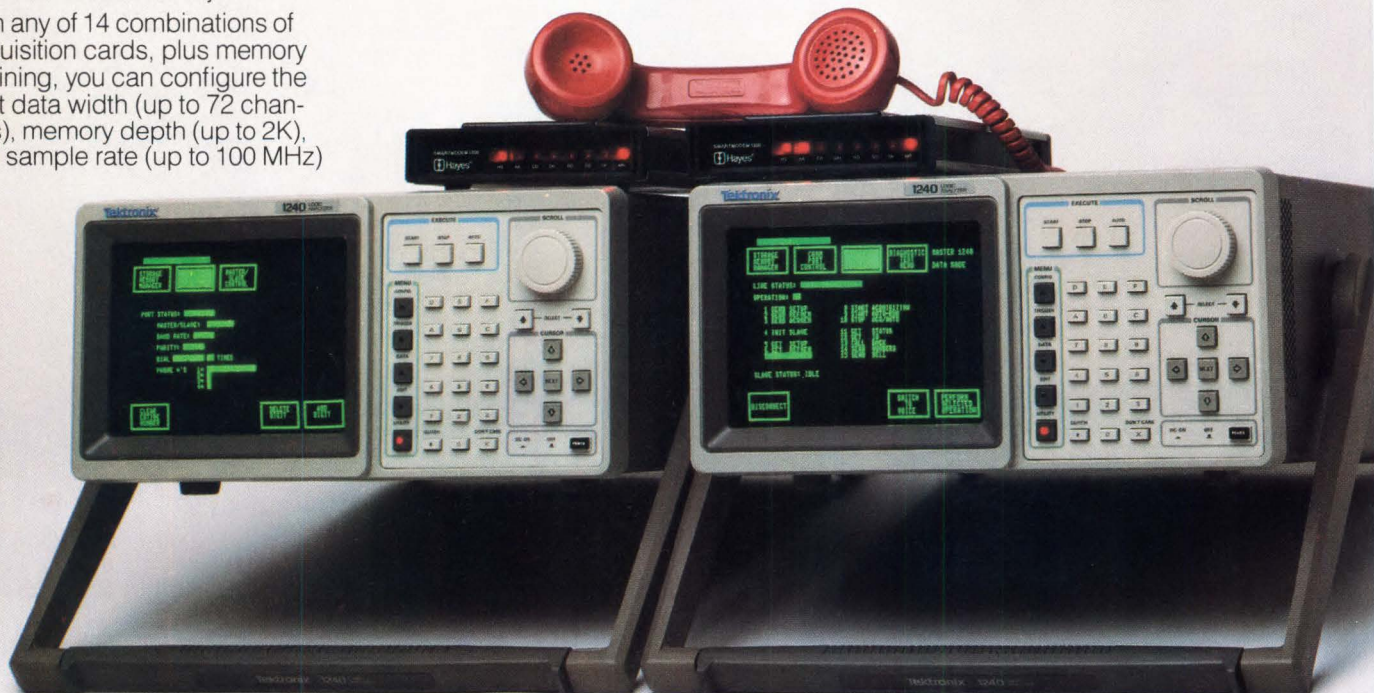
With any of 14 combinations of acquisition cards, plus memory chaining, you can configure the best data width (up to 72 channels), memory depth (up to 2K), and sample rate (up to 100 MHz)



makes teleservicing eminently practical by allowing two 1240's to communicate via phone lines.

In black-and-white, the 1240 is your best guarantee that problems will never evolve beyond what your logic analyzer can handle.

For more reasons, on-paper or in a personal demonstration, why the 1240 is the best of the best-selling logic analyzers, call 1-800-547-1512. In Oregon, call 1-800-452-1877. Or contact your local Tektronix Sales Engineer.



Tektronix
COMMITTED TO EXCELLENCE

CIRCLE 28 FOR LITERATURE

CIRCLE 29 FOR SALES CONTACT

CONFERENCE PREVIEW

Wescon '84 gives the nod to DSP and data-comm ICs and to surface mounting

At this week's conference, fast processors and special-purpose chips take the spotlight, sharing it with surface-mounting technology.

Digital signal processing and data communications will garner the lion's share of attention when Wescon '84 opens its doors this week in Anaheim, Calif. Faster and potentially less expensive chips are now in the works, complemented by progress in packaging, specifically in surface mounting.

New structures and speed characterize the latest digital signal processors. Word-slice processors are emerging, with some dissipating even less power than their predecessors, the 2900 bit-slice processors. The new 16-bit-slice chips share the digital signal-processing limelight with blazingly fast multipliers and specialized chips like digital correlators.

Perhaps the best news for designers of data communication systems is about the chips that are converting the high-level constructs and protocols of local networks into silicon, acting as the glue that mapping those models into a physical system. Already chips have been developed for many applications including

packet-switching and Ethernet protocols.

Of course, with so much concern these days about system cost, surface-mounted packages are understandably becoming a favorite among system designers. Not only do they trim board real estate, they also slash manual assembly time and costs. Industry estimates claim that more than 10,000 surface-mounted devices have already been introduced.

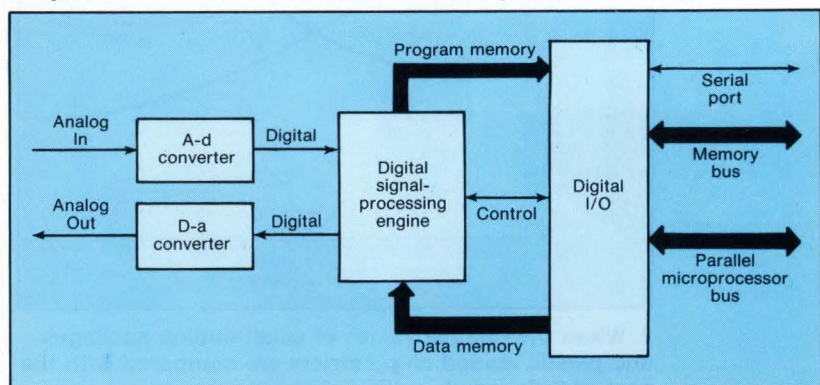
Slicing for speed

System builders on the lookout for extremely fast processors will be particularly interested in two 16-bit-

slice processors with architectures similar to that of the 2900. One chip is a fully custom design, the other a gate array; both cycle in 100 ns. The fully custom chip uses microcode that is compatible with the 2901B bit-slice chip. Built with a 2- μ m CMOS process by Synertek Inc. (Santa Clara, Calif.), the chip contains a carry look-ahead unit for performing fast arithmetic.

The second, also a CMOS unit, comprises a 4000-gate array and emulates four 2901 bit-slice processors and their 2902 carry look-ahead component. Designed by International Micro Circuits Inc. (Santa Clara, Calif.), the chip now runs at 5 MHz, though it should see 8 MHz by next year.

Once the chip's gate density begins to rise, special customization will likely enhance the 2900-like architecture further. For instance, buffering the addresses, instructions, and I/O would eliminate processing delays and replace some of the glue logic normally surrounding bit-slice



1. A general-purpose digital signal processor from Advanced Micro Devices could be placed in any host system as a specialized microcontroller. It consists of an I/O subprocessor, a processing engine, and data converters.

Ray Weiss

CONFERENCE PREVIEW

processors.

From a speed vantage, little compares with the latest special-purpose chips. One 16-bit multiplier, for instance, can operate at a clock rate of 20 MHz. Its manufacturer, TRW Inc.'s LSI Products Division (La Jolla, Calif.), has also developed a digital correlator that accepts as many as 128 bits serially. (Correlation compares a reference signal with an incoming signal, detecting the disguised reference signal through a combined sampling-and-integration technique that is performed over time.) The TMC2220 correlator contains four identical 32-tap modules (ELECTRONIC DESIGN, May 17, 1984, p. 175), and the TMC2221 is a single-bit correlator.

Digital replacements

As the benefits of digital signal processing become more evident, system designers may expect to find chips geared for less tradi-

tional jobs, perhaps those usually handled by analog circuits.

Take a subscriber-line audio processing chip geared specifically for telephone systems. Developed by Advanced Micro Devices Inc. (Sunnyvale, Calif.), the chip proves a competent substitute for the customary analog codec and filter (Fig. 1), and it also contains six user-programmable filters for balancing the lines. At the user's request, the processor can set the filtering parameters.

Ultimately, a general-purpose digital signal processor is not out of the question. For that type of device, software would probably control the parameters of the digital processing and the analog I/O functions. The chip's first use might be in process control, signal conditioning, or filtering—not traditional tasks of high-speed digital signal processors.

As those chips evolve from the specific to the general,

data communication processors are taking on heavier loads. Witness a VLSI coprocessor that internally handles bit-oriented, frame-based protocols like SDLC, HDLC, X.25, and ADCCP.

Inside the chip, Exel Microelectronics Inc. (San Jose, Calif.) puts two subprocessors, one for controlling the data link and the other for channel traffic (ELECTRONIC DESIGN, July 26, 1984, p. 155). The coprocessor, which shares the host bus, frees the host from packet- and frame-processing tasks.

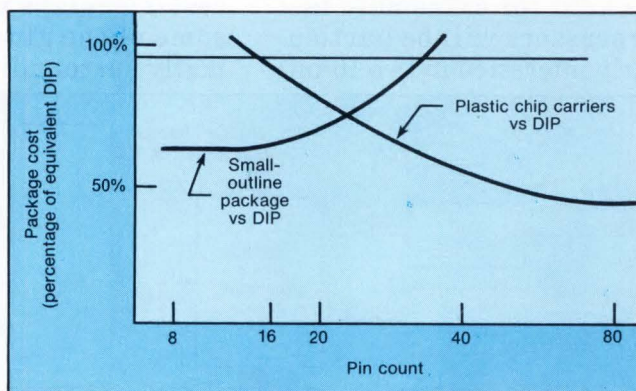
Another VLSI solution—a three-chip set—can implement the control functions for both Ethernet and Cheapernet. Built by National Semiconductor Corp. (Santa Clara, Calif.), the set forms the heart of a network in which Ethernet serves as the backbone and Cheapernet provides the inexpensive nodal connections. (Cheapernet differs from Ethernet because it limits the total network distance and the number of stations, thereby cutting the cost of individual nodes.)

Big things, small packages

The more complex the chips, the more innovative package designers must be. Surface-mounting technology (SMT) gains converts daily, yet the jury is still out on its overall cost advantages.

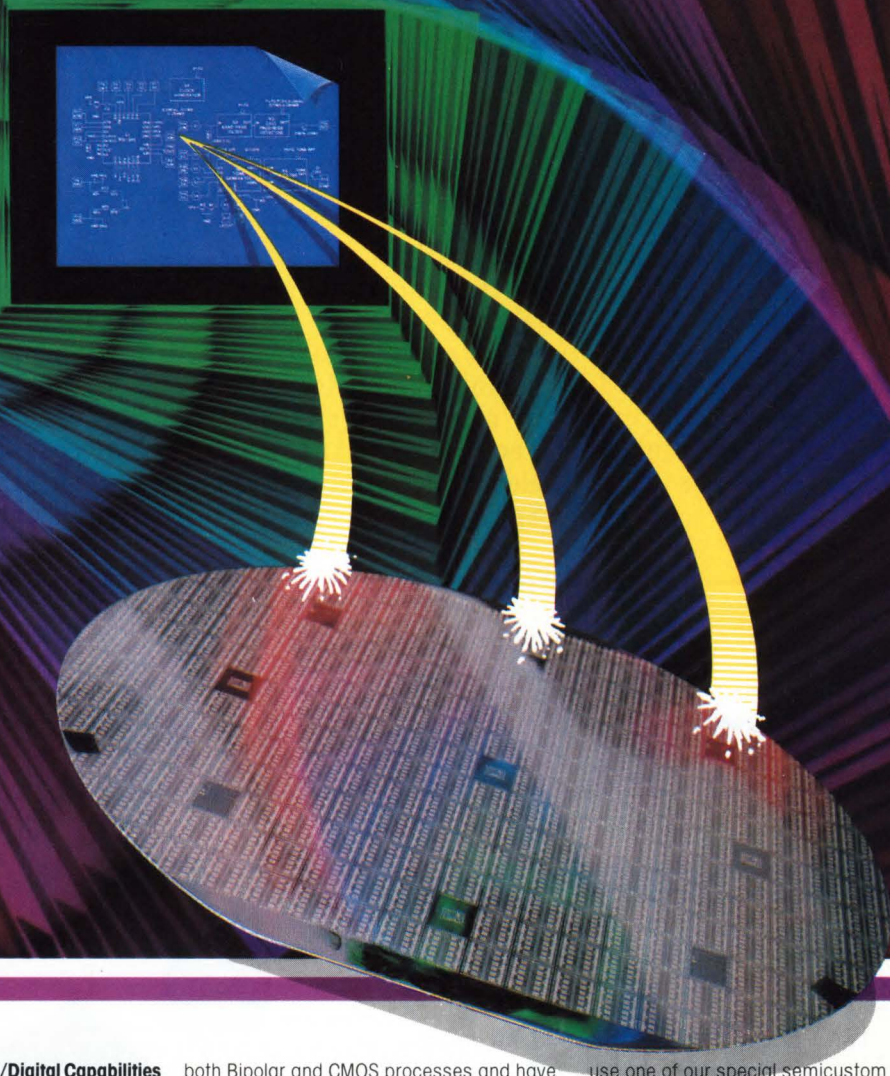
To gauge the technology's benefits, consider the following:

- Chip packaging costs can plummet 30% to 50% by going from DIPs to surface-mounted packages (especially



2. When the relative values of small-outline packages and plastic leaded chip carriers are compared with the cost of DIPs, small-outline packages are clearly more economical at low pin counts. On the other hand, the chip carriers become increasingly less expensive as pin count rises above 16 pins. (The chart assumes matching volume.)

NO ONE INTEGRATES SYSTEMS WITH CUSTOM/SEMICUSTOM CHIPS BETTER.



Analog, Digital, and Analog/Digital Capabilities

There are many ways for putting digital systems on a chip, and, of course, we can provide digital solutions. But the going gets tough when the systems are analog, and it gets really sticky when you need both analog and digital on the same chip. You can immediately rule out all the gate array guys and look to the real custom/semicustom chip experts. You can look to Silicon Systems—a company that's built its growth on its combined analog/digital capabilities.

Bipolar and CMOS Processes

Silicon Systems' automated wafer fab is not restricted to a single technology. We offer

both Bipolar and CMOS processes and have no bias in steering you toward one technology or the other. So you can be sure that we'll only recommend the process that is best for your system solution.

Standard Cells or Full Custom

Everyone knows that with moderate-to-large volume production, a full custom chip is the optimum approach. But everyone thinks it takes a long time and a lot of money to get there. Not at Silicon Systems. We can implement your design with selections from our standard cell library of digital and analog circuits that combine quality performance with fast-turnaround. Or perhaps you could

use one of our special semicustom switched capacitor arrays that can be easily tailored for a variety of special filter applications. And when the time is right, we can lead you promptly and painlessly into a full custom design, using our unique Integrated Design Methodology (IDM™).

So, Silicon Systems has the answer for you. For the full story, send for our new Custom/Semicustom Integrated Circuits brochure.



Silicon Systems, 14351 Myford Road, Tustin, CA 92680. (714) 731-7110.



CIRCLE 30 FOR PRODUCTION INFORMATION

CIRCLE 31 FOR CAREER INFORMATION

CONFERENCE PREVIEW

for SSI and MSI chips).

- Mounted chips could reduce board size by 30% to 70%.
- Surface mounting is geared for automated fabrication.
- Mounted packages have 50% to 70% less volume than their DIP equivalents.

Besides its impact on board space and component size, surface mounting also improves the electrical performance of printed circuit boards. Shorter leads and routing paths reduce trace inductance from 7 to 1, resistance from 5 to 1, and parasitic capacitance from 10 to 1. Thus surface-mounted systems have fewer inductive noise spikes, and less interference.

Two types of surface-mounted packages are now being used: the small-outline package has "gull wing" leads for ICs with fewer than 20 pins, and the plastic leaded chip carrier is designed for more leads, which have a J form. Texas Instruments Inc.'s Corporate Research Laboratory (Dallas) has been studying surface mounting and has charted the cost vs pin count for both small-outline and plastic packages (Fig. 2).

But acceptance of surface-mounted technology is driven by more than cost. United Technologies Inc.'s Microelectronics Center (Colorado Springs, Colo.) considers the

packaging technique a perfect candidate for the Department of Defense's VHSIC program. Chips for that project will strain the limits of today's packages, since they will require 100-MHz clock rates, dissipate up to 4 W, and pack about 200 pins.

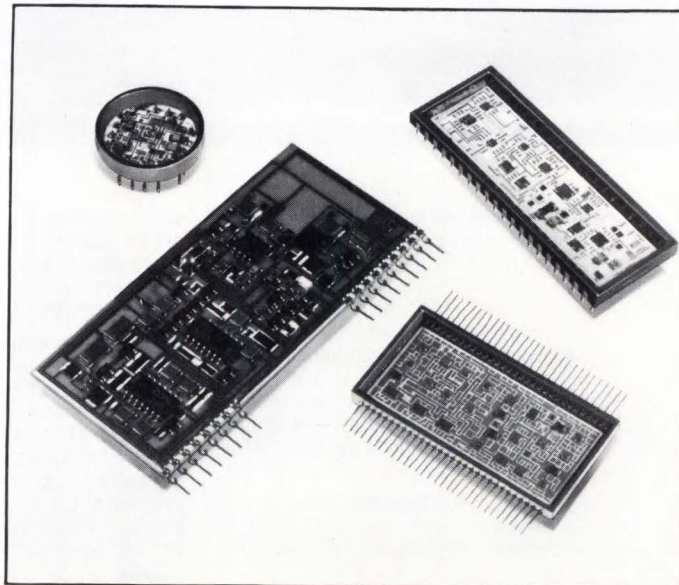
Mounting pin-grid arrays and plastic chip carriers on a board's surface seems to be the best route, because it minimizes real estate requirements and the electrical complications caused by the higher clock rate. Decoupling capacitors, built into the packages themselves, may be necessary to further reduce electrical problems in these high lead-count packages. □

We sell Hybrid Solutions.

For years we've been supplying industry with hybrid solutions to their circuit design problems. Our thick-film hybrids are used in Oil Logging Instrumentation, Telecommunications, Computers, Medical Electronics, and by the Military in airborne, satellite, missile, and fuze applications to MIL-STD-883.

Our standard products include crystal and solid-state oscillators, precision voltage references, voltage regulators, amplifiers, active filters, analog switches, and more. Many of our stock items are designed to operate all the way up to +200°C. We also have a large inventory of Encoders, Decoders, and Tone Squelch products for the Communications Industry.

We're in computers and control systems, radios and robots, ATE and aircraft. And, we'll go anywhere there is a problem to be solved. When you're looking for your next hybrid solution give us a call. Whether it's kilohertz or gigahertz, standard or custom, easy or tough, we think you'll like our response. Remember, we speak fluent hybrid.



For Your Hybrid Solutions,
Visit Our WESCON Booth #2248

White Technology, Inc.

4246 E. Wood Street • Phoenix, Arizona 85040 • (602) 437-1520 • TWX 910-951-4203

CIRCLE 32

PRO-LOG ANTICIPATES THE MOS PROM INNOVATORS

WE'RE TURNING MOS ADVANCES
TO YOUR ADVANTAGE —
RIGHT IN THE FIELD

Pro-Log's versatile PROM programmer keeps you right in step with Intel's advanced MOS technology. Updating for Intel's new EPROMs is fast and easy — with our PM9080 universal MOS personality module. You simply re-program it yourself, right where you are. Nothing to send back to the factory.

INTEL INNOVATES

Intel's 27256, based on HMOS* II-E process technology, offers you the highest density available today. Their 2764A and 27128A EPROMs are advanced versions of today's 64K and 128K EPROMs. Both are faster and lower power than their predecessors. All their EPROMs contain intelligent Identifier™ bytes which your programmer can read — ensuring that EPROMs are correctly programmed.

PRO-LOG ANTICIPATES

Pro-Log anticipated Intel's innovations, and we're also anticipating innovations from Seeq (Silicon Signature™), Fujitsu, and Motorola. Watch for our announcements.

Stay current. Update today the Pro-Log way.



PRO-LOG®
CORPORATION

INVENTORS OF THE STD BUS

2411 Garden Road
Monterey, California 93940
408-372-4593, TLX: 171879
Outside CA: 800-538-9570

Offices and Phone: Australia (3) 836-3533; Benelux (76) 225322;
Canada (416) 625-7752; England (276) 26517; France (3) 956-8142;
Italy (2) 824-2112; Switzerland (1) 491-2121

*HMOS is a patented process of Intel Corporation.
intelligent Identifier™ is a Trademark of Intel Corporation
Silicon Signature™ is a Trademark of Seeq Technology, Inc.

CIRCLE 33

©1984 ADGroup International  034A

Kontron has integrated the micro design tools, so your engineers don't have to.

With the time you save, you'll

Engineers can work together more efficiently and design better products when their tools work together—which is one reason why Kontron's integrated Tool Set for microprocessor-based product development makes so much sense.

Full integration and networking increase productivity

It has a single, integrated operating environment and database, so everyone operates from the same information, whether they're designing hardware, programming, or producing documentation.

It's fully networkable, so if you add new team members you can easily

expand the system. All the specs, memos, and code in other people's machines are immediately available, so the new people can become immediately productive.

Comprehensive CAD software

Comprehensive CAD software not only eliminates hundreds of man hours per project (by eliminating tedious, repetitive drafting tasks); it also brings gate array designs within the range of projects where only a few hundred units will be built.

Faster information flow

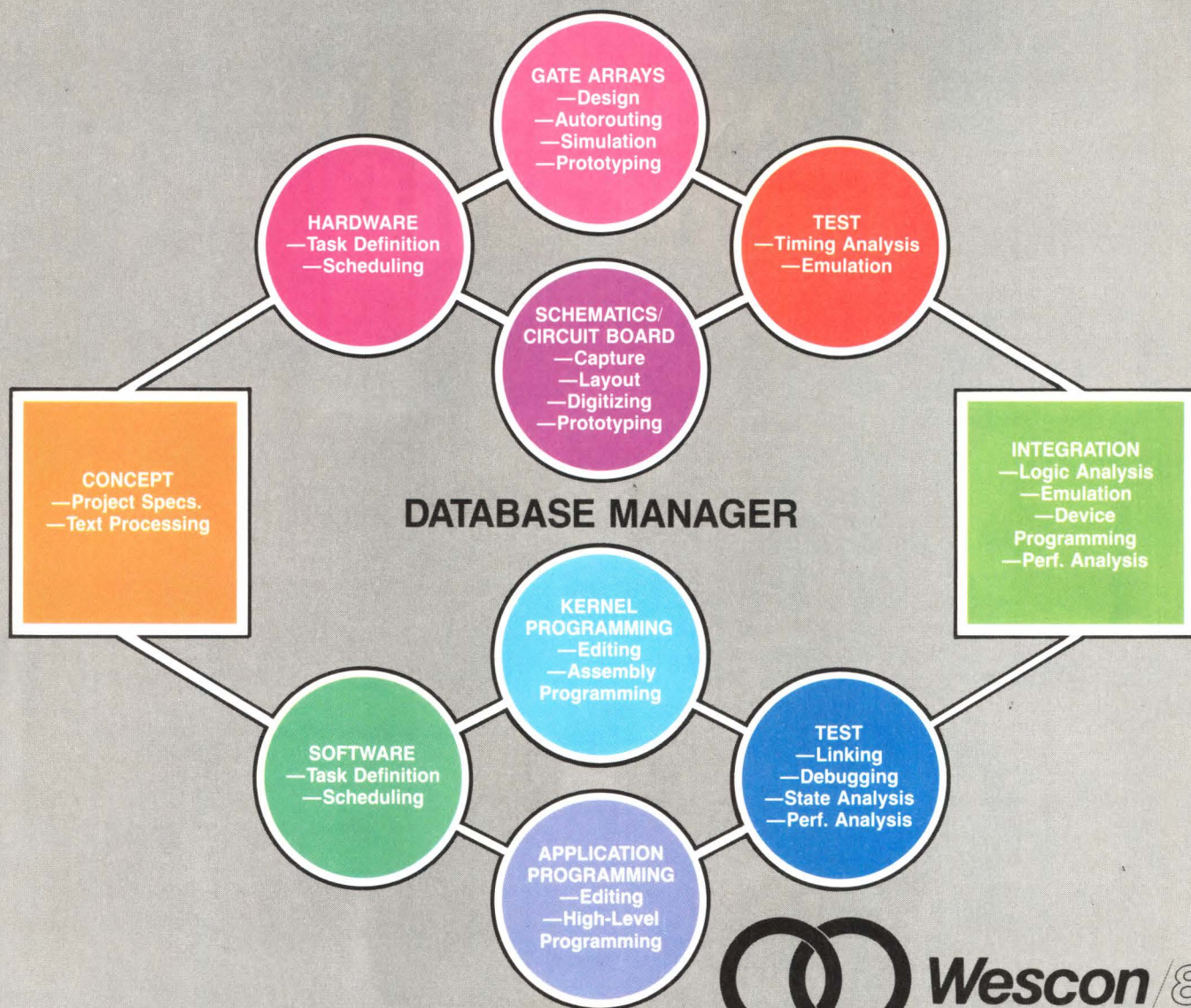
In addition to all these engineering features, the Kontron Tool Set of-

fers convenience features like word processing and electronic mail that simplify information flow. It's modular in design, and all the tools can be used independently. You can buy just those capabilities you need and expand as required, without being locked into a particular approach.

Complete product line

The Kontron Tool Set includes UNIX®- and CP/M®-based microprocessor development workstations; interfaces to IBM PCs and VAX computers via Kontron's TEAMWORK BUS™; logic analyzers with up to 64 channels and 100 MHz capture capability; real time in-circuit emulators for 8-

TYPICAL DESIGN CYCLE



get better products—faster.  **Wescon/84[®]**

and 16-bit microprocessors; PROM programmers for over 500 devices; and MICAD software for computer-aided design of both PC boards and gate arrays.

Write for a 32-page booklet with complete technical information:

KONTRON ELECTRONICS INC.
630 Price Avenue
Redwood City, CA 94063
800/227-8834
(415/361-1012 in California)

D-8057 Eching/Munich,
West Germany, Breslauer Str. 2,
089/3 1901-0.

*UNIX is a registered trademark of AT&T.

*CP/M is a registered trademark of Digital Research, Inc.

CIRCLE 78 FOR LITERATURE



ADVANCED
ELECTRONIC
INSTRUMENTATION

**KONTRON
ELECTRONICS**

"SEE OUR BOOTH 1631 AT WESCON"

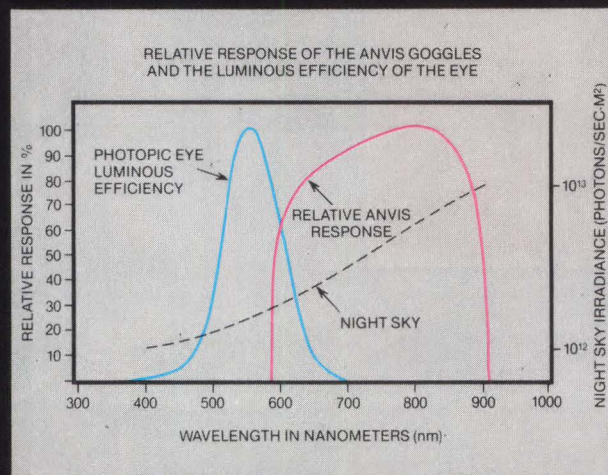
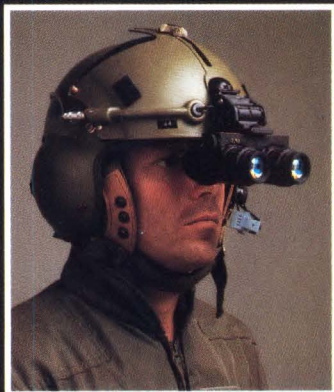
CIRCLE 79 FOR DEMONSTRATION

It works the night shift.



When you're working with ANVIS night vision goggles, you also want to be working with the new Vivisun 20/20 switches. A unique optics system eliminates the veiling glare and halo effect of conventional displays. When voltages are trimmed to night vision goggle flying levels, Vivisun 20/20 switches can still be read with the unaided eye.

During the day, Vivisun 20/20 switches are readable in direct sunlight and deadface when not energized. They are also easy to install and have the lowest touch temperature and widest viewing angle in the industry. Clearly, no other Mil-Spec switch can



match it. And you can specify your Vivisun 20/20 switches with these options: Dustproof/Dripproof • Split Ground • P.C. Termination • EMI. For more information, write, phone or telex today.



AEROSPACE OPTICS INC.

3201 Sandy Lane, Fort Worth, Texas 76112
(817) 451-1141 • Telex 75-8461



VIVISUN 20/20

MIL-S-22885/90

NEWS ANALYSIS

Emulators shift from design to production and field testing

By adding some new wrinkles, emulation is becoming as familiar to test engineers and troubleshooters as it is to designers.

Essential to designing microprocessor-based systems are the emulation techniques called into play to control and observe the operation of the target. As such systems grow in number and complexity, variations on these well-established techniques are being pressed into service both in production testing and in the field.

For their parts, designers are concerned with determining that their progeny are without any logical flaws. Test engineers, in contrast, are concerned with identifying and diagnosing all the possible faults on a mass-produced design, which means looking for a wider range of problems.

To complicate matters even more, some faults only appear when all of a board's components are active. The waters are further troubled by the need to check out boards quickly and the complementary demand to diagnose the problems rapidly, preventing

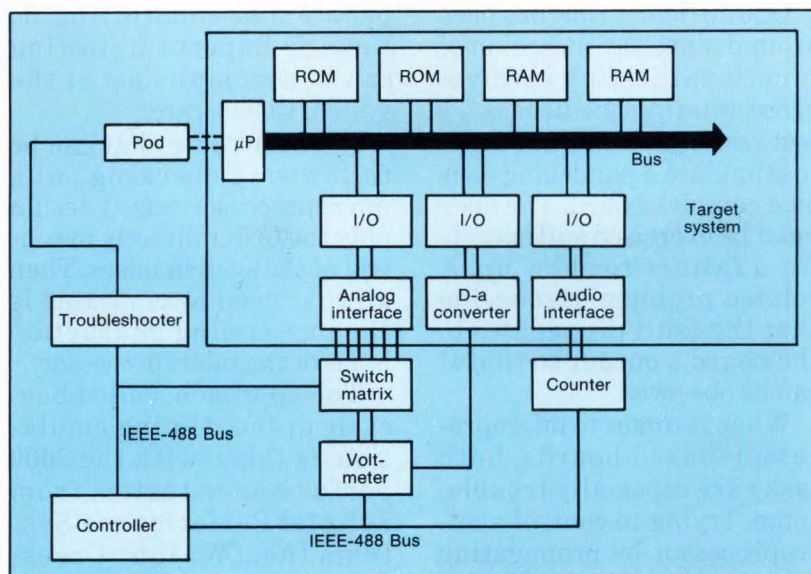
known bad boards from piling up.

For sophisticated designs that are being manufactured in low volumes, a development system may actually be set up to perform testing. Such testing is slow and cumbersome and is no substitute for in-circuit emulation on a

general-purpose tester (ELECTRONIC DESIGN, Oct. 18, p. 132).

Adding an in-circuit emulator to an in-circuit tester simplifies and speeds up the chore. That is just the approach taken by Fairchild Test Systems (Titusville, Fla.), which has added an in-circuit emulator to its 3000C in-circuit tester. The 3050C ICEolator functionally tests a range of microprocessor-based boards.

A number of test stations are hard at work checking out boards that feature a large amount of analog circuitry. These testers are often assemblies of standard instruments that are controlled by the IEEE-488 interface bus. When they examine micro-



1. A tester that can be controlled over the IEEE-488 interface bus is important for checking out microprocessor-based boards. The 9020A Micro-System troubleshooter, from Fluke, substitutes for the target's microprocessor and exercises the hardware in response to commands issued by the controller.

Bob Milne

NEWS ANALYSIS

processor-based boards, the job can be simplified with the 9020A Micro-System troubleshooter, from John Fluke Manufacturing Co. Inc. (Everett, Wash.). The unit, which employs in-circuit emulation, substitutes for the processor of the system under test and is directed over the IEEE-488 bus.

With this arrangement, the test system's bus controller can directly stimulate the target by issuing commands to the 9020A (Fig. 1). The controller, for instance, could issue commands to the troubleshooter directing it to write data to the locations that turn on an analog voltage. Instructions could then be issued to a voltmeter to measure the voltage and transmit its value to the controller for evaluation.

A familiar problem

One difficulty that has been around since the inception of functional testing involves programming the necessary test vectors to a circuit's input to stimulate a particular node on a complex board. The node must be exercised sufficiently for a failure to show up. A related problem is ensuring that the fault propagates to the board's output so that it can be observed.

When it comes to microprocessor-based boards, both tasks are especially troublesome. Trying to control a microprocessor by propagating test vectors from a card-edge connector through layers of logic is not easy. Indeed, it quickly turns into a programmer's nightmare. Similarly,

attempting to determine what is happening on the buses by looking at the outputs of the card-edge connector is equally difficult.

Swapping memories

Memory emulation is the path taken in a system that employs a test clip to establish a connection to the microprocessor while it is still in situ. Then the 2720 performance test system, from GenRad Inc. (Concord, Mass.), uses in-circuit backdriving, or overdriving, to redirect the microprocessor to read from the tester's memory instead of the system's memory.

The tester simplifies programming because routines can be written in the microprocessor's native language. What's more, the emulator can make use of any self-testing routines already written for the target, solving the problem of controlling it. Equally important, testing can be accomplished at the system's clock rate.

Another route that can be followed in checking out a microprocessor-based design puts the tester directly in control of the system buses. Then all that need be emulated is the bus-timing characteristics of the microprocessor.

The approach, called bus-cycle or bus-timing emulation, is taken with the 2000 performance tester, from Zehntel Performance Systems Inc. (Walnut Creek, Calif.). Since testing is accomplished by bus reads and writes, the system is programmed using universal instructions. That eliminates

programming with processor-dependent, assembly-language mnemonics.

Bus-cycle emulation is also a feature of the L200 series testers from Teradyne Inc. (Boston, Mass.). Dubbed automatic bus cycle (ABC) emulation, the technique is part of the tester's multiple-mode test strategy, which links combinations of in-circuit and functional techniques to optimize testing and diagnosis efficiency.

The unit contains a library of timing characteristics for a variety of microprocessors and buses. The bus-cycle generator makes use of those characteristics. If a device is listed in the library, the generator automatically constructs basic bus cycles, such as memory read, memory write, I/O read, and I/O write.

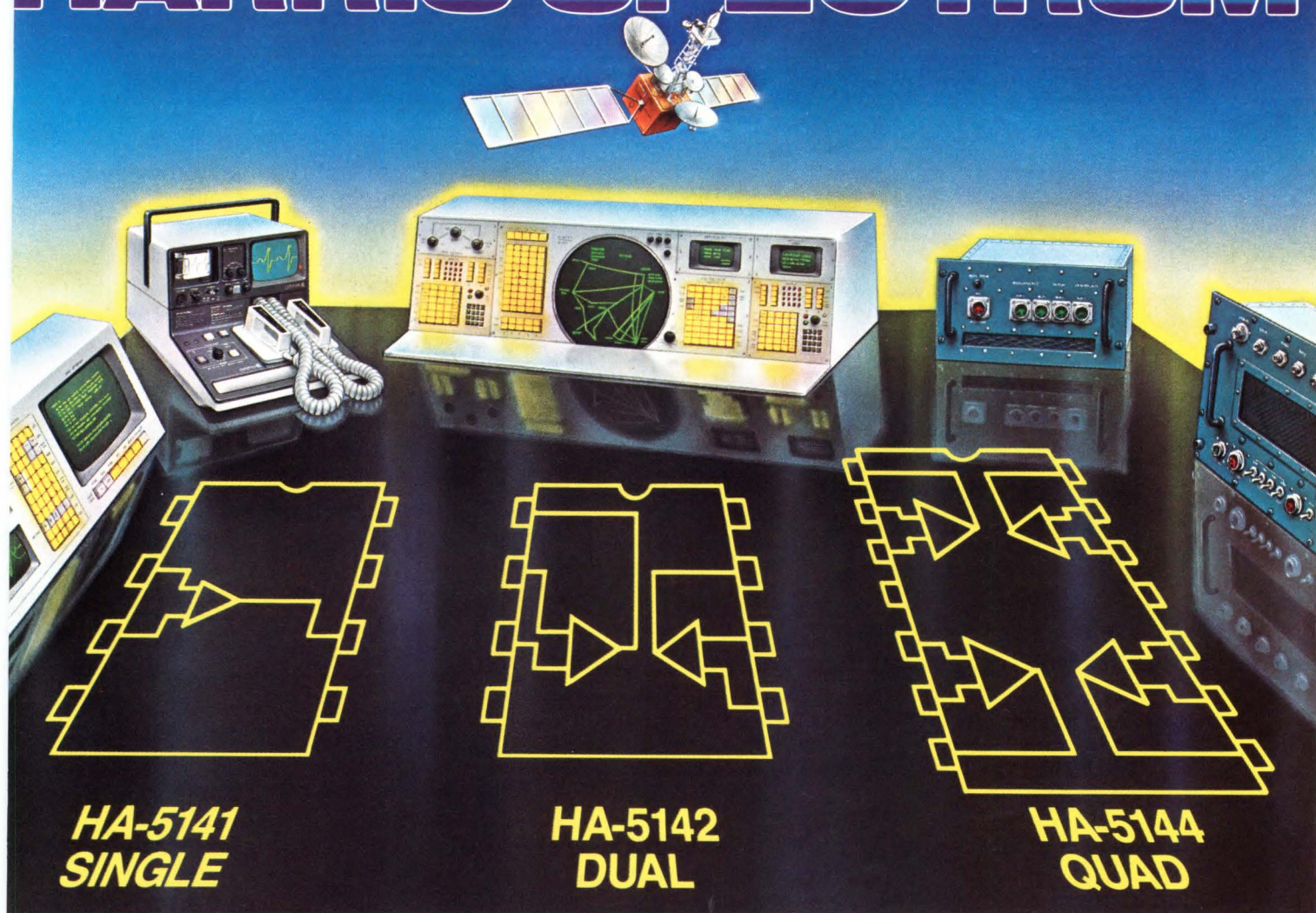
Displaying waveforms

Moreover, the cycle generator creates waveform displays using high-intensity video to indicate where test windows open and close for each signal. If any illegalities are found as the display is generated, the test engineer is alerted.

If production testing problems seem formidable, imagine attempting to diagnose a fault in the field. Little may be known about the intimate workings of the board, and documentation itself may be sparse.

The real trouble lies in knowing where to start troubleshooting. The microprocessor may control the board, but once a fault occurs, the

HARRIS SPECTRUM



**HA-5141
SINGLE**

**HA-5142
DUAL**

**HA-5144
QUAD**

Now, new micropower op amps offering the best power consumption/speed ratio and the lowest noise!

Presenting the Harris HA-5141 family—the HA-5141 (single), HA-5142 (dual) and HA-5144 (quad)—unrivaled for low power, low noise and speed.

Micropower op amps that provide the AC and DC performance of general-purpose op amps yet draw only 1/20 the power.

They're all available now with these outstanding performance characteristics:

- 50 μ A supply current (per op amp)
- Low noise (20 nV/ $\sqrt{\text{Hz}}$)
- 400 kHz gain-bandwidth product
- 0.5 mV input offset voltage
- Low (50 nA) input bias current
- High (100 kV/V) open loop gain

Combine these with a 1.5 V/ μ s slew rate and single or dual supply operation capability, and you have an op amp family that demands very little and produces a lot—in your low-power instrumentation, audio amplifier and active filter design applications.



The high-speed/low-power characteristics of the HA-5141 family are ideal for portable system applications such as dictation equipment, medical monitoring systems and remote electronic sensors. And they are your best choice for all battery-powered equipment.

They operate over a wide range of power supplies (± 15 V down to ± 1.5 V with dual supplies, +30 V down to +3 V with single supply). HA-5141 and HA-5142 are available in can or minidip packages; HA-5144 comes in a 14-pin dual-in-line package. All with industry-standard pinouts that are pin-compatible with most other op amps.

For more details, write: Harris Semiconductor Analog Products Division, P.O. Box 883, MS 53-035, Melbourne, Florida 32902-0883.

Harris Semiconductor: Analog - Bipolar Digital
CMOS Digital - Gallium Arsenide - Semicustom - Custom



HARRIS

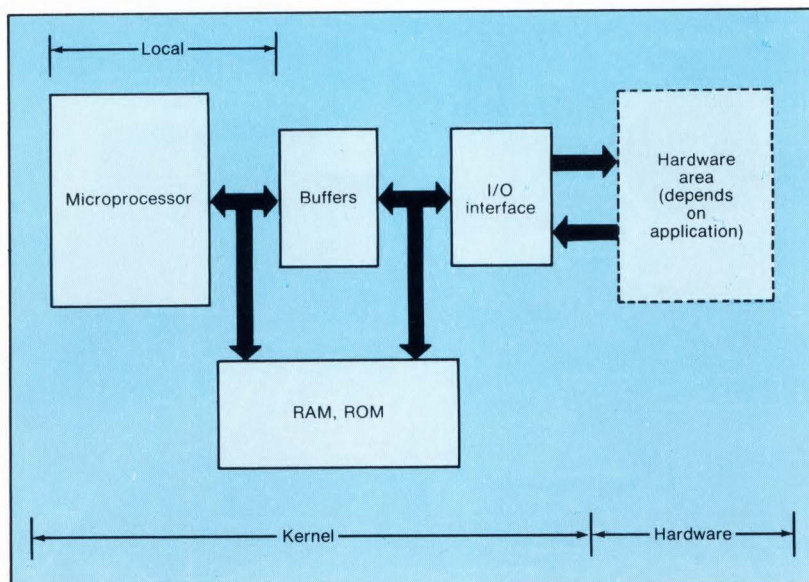
CIRCLE 116

For your information, our name is Harris.

Visit us at the Wescon Show in Anaheim, CA, Oct. 30–Nov. 1 at the Hamilton/Avnet Booth #3680.

Visit us at the Electronica Show in Munich, West Germany, Nov. 13–17 at the Harris-MHS Booth #19A8, Hall 19.

NEWS ANALYSIS



2. A logical approach to diagnosing faults in a microprocessor-based system begins with tests that verify the local area within the kernel circuitry. Then troubleshooting proceeds to the rest of the kernel, such as RAM, ROM, and I/O. Once these sections are checked out, the hardware area can be tested.

latter may control the microprocessor. Further, if the fault disrupts a basic function of the CPU, as a stuck-at-1 address bit would, self-testing routines may not be operational.

A new breed of instruments—based on in-circuit emulation—employs powerful diagnostic routines to attack these problems. These routines enable the diagnostician to start troubleshooting even if little

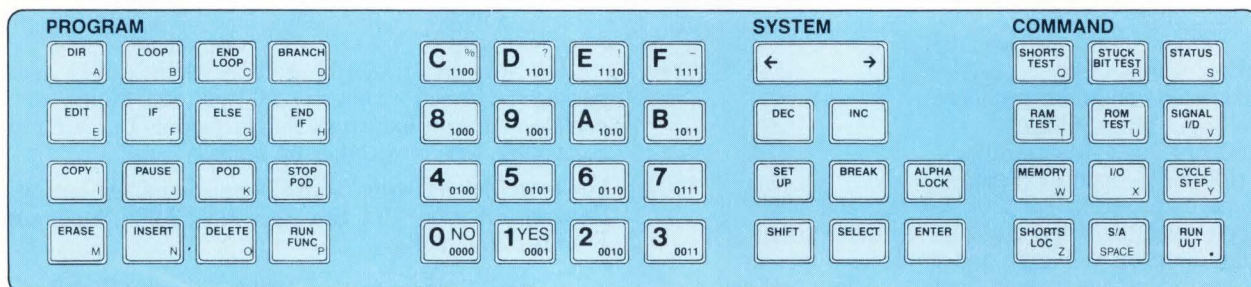
is known about the system under test. Interestingly, the units are proving invaluable for debugging hardware in the development lab as well.

The 9010A Micro-System troubleshooter from Fluke started the ball rolling several years ago. This year, another player entered the ring—the ET-2000 Micro Trouble Shooter from Applied Microsystems Corp. (Redmond, Wash.).

These units enable troubleshooting to proceed logically, based on the common structure inherent to any microprocessor-based system. For diagnostic purposes, these systems can be broken down into three major sections: the kernel circuitry, which includes the microprocessor, RAM, ROM and I/O; a local area within the kernel, comprising the microprocessor and the electrical connections to it; and a unique hardware area beyond the kernel (Fig. 2).

As with standard in-circuit emulators, a microprocessor-specific pod links to the target, substituting for the CPU. Troubleshooting begins with determining the electrical integrity of the local area. Using conventional instrumentation, that is a fairly laborious task. The troubleshooters, in contrast, accomplish it with just a few keystrokes.

The connections to the processor, say, can be checked for shorts to ground and against each other. Once the local area is verified, the examination proceeds to the rest of the kernel. Once again, a few keystrokes test entire sec-



3. Some tests on microprocessor-based boards are normally hard to perform in the field, such as discovering shorts and stuck bits. Programs to handle these problems are contained in the ET-2000 Micro Trouble Shooter. The keyboard is laid out in three major sections: program, system, and control.

DDC NEWS

ABOUT SYNCHRO-CONVERSION • HIGH-SPEED, HIGH ACCURACY D/A & A/D CONVERSION • DATA BUS DEVICES

PUBLISHED BY

ILC DATA DEVICE CORPORATION

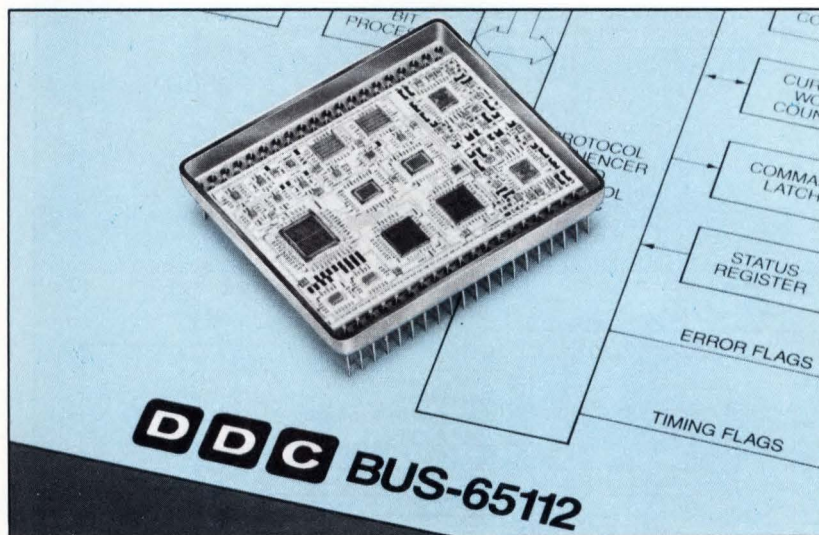
OCTOBER 1984

THE LOWEST COST DUAL REDUNDANT 1553 RTU IN A SINGLE PACKAGE

DDC is pleased to announce the availability of BUS-65112, its new low cost intelligent Remote Terminal Unit (RTU). Based upon DDC custom monolithics, BUS-65112 is packaged in a small 1.9" x 2.1" hybrid and includes 2 transceivers, 2 encoder/decoders, 2 bit processors, RTU protocol, data buffers and timing control logic. It includes complete Remote Terminal protocol and supports all 13 mode codes for dual redundant operation, any combination of which can be illegalized. At \$1436,* the BUS-65112 is the price/performance leader in its class.

Data is transferred to and from the subsystem host CPU over a 16 bit parallel highway, which is isolated by a set of bidirectional buffers. BUS-65112 is compatible with most host CPUs, with its data transfers of request, grant, acknowledge DMA type handshaking. For those subsystems interfacing directly to RAM memory, read/write and data strobe control signals are provided to simplify the interface. BUS-65112 also provides latched outputs for the command word and word count. These signals can be used as address lines to map 1553 messages directly to and from RAM.

Inputs are provided to the host CPU to control 6 of the bits in the RTU Status Word. Particularly useful is the Illegal Command line, which may be used to set the message error bit and illegalize any combination of the 13 mode commands that the BUS-65112 executes. An external PROM, programmed with illegal mode commands, monitors the latched Command Word.



When the PROM identifies a mode command that is illegal, it drives the Illegal Command line LOW. The other Status Word bits that are host CPU controlled are: Subsystem Request, Accept Dynamic Bus Control, Remote Terminal Flag, Subsystem Busy, and Subsystem Flag.

Four error flags are provided to the host CPU to aid in assessing its condition. These error flags are Message Error, Remote Terminal Failure, Handshake Failure, and RT Address Error. The RT Failure flag reports the results of the BUS-65112 continuous online self-test. Each transmitted message is wrapped around to the decoder and compared to the correct message.

The BUS-65112 includes a 14 bit Built-In-Test (BIT) word register. The stored BIT Word contains information about the state of the Remote Terminal. When a Mode Command is received to transmit

BIT Word, the contents of this register are transmitted over the 1553 data bus. Individual bits provide information relating to transmitter timeouts, loop test failures, transmitter shutdown, subsystem handshake failure, and the results of individual message validations.

BUS-65112 is available screened to the requirements of MIL-STD-883, and it operates over the full -55°C to +125°C temperature range.

Learn more about DDC's new BUS-65112 and how it can efficiently improve your 1553 data bus designs while cutting costs at the same time. Call the nearest DDC office listed below for prompt sales and applications assistance. □



*Domestic prices, 25-49 units

CIRCLE 37 FOR LITERATURE

CIRCLE 38 FOR SALES CONTACT



ILC DATA DEVICE CORPORATION

HEADQUARTERS AND MAIN PLANT: ILC Data Device Corporation, 105 Wilbur Place, Bohemia, N.Y. 11716, (516) 567-5600, TWX: 510-228-7324
WEST COAST: ILC Data Device Corporation, Woodland Plaza, 21243 Ventura Boulevard, Suite #123, Woodland Hills, CA 91364, (818) 982-6454, TWX: 910-499-2674
WASHINGTON, D.C. AREA: ILC Data Device Corporation, 2110B Gallows Road, South Tysons Corner Office Park, Vienna, VA 22180, (703) 893-7989, TWX: 910-997-0967
EUROPEAN OFFICE: ILC Data Device Corporation, 40 Triton Square, London NW1 3HG, England, 01-387 4599, TLX: 851-261967
UNITED KINGDOM: DDC United Kingdom Ltd., 128 High Street, Hungerford, Berkshire, RG17 0DL, England, (44) 488-82141, TLX: 851-848826
FRANCE: DDC Electronique, 4 Rue de l'Abreuvoir, 92400 Courbevoie, France, (1) 333-5888, TLX: 842-630609
WEST GERMANY: DDC Elektronik, GmbH, Vorderer Anger 286, P.O. Box 1212, 8910 Landsberg A.L., West Germany, Tel: (08191) 3105, TLX: 841-527128
JAPAN: DDC Electronics K.K., 1-32-3, Nishi-Gotanda, Shinagawa-Ku, Tokyo 141, Japan, Tel.: (03) 490-0203, TLX: 781-34158

"SEE US AT WESCON '84, BOOTH 3662 & 3664 ANAHEIM, OCT. 30 - NOV. 2"

NEWS ANALYSIS

tions of the kernel, such as RAM and ROM.

The Fluke 9010A even has a so-called learning mode that comes up with a memory map

of the target. When it is invoked, the unit tries to read from and to write to every memory location a particular processor is capable of ad-

ressing. Based on the responses, an algorithm determines the address locations of RAM, ROM, and I/O.

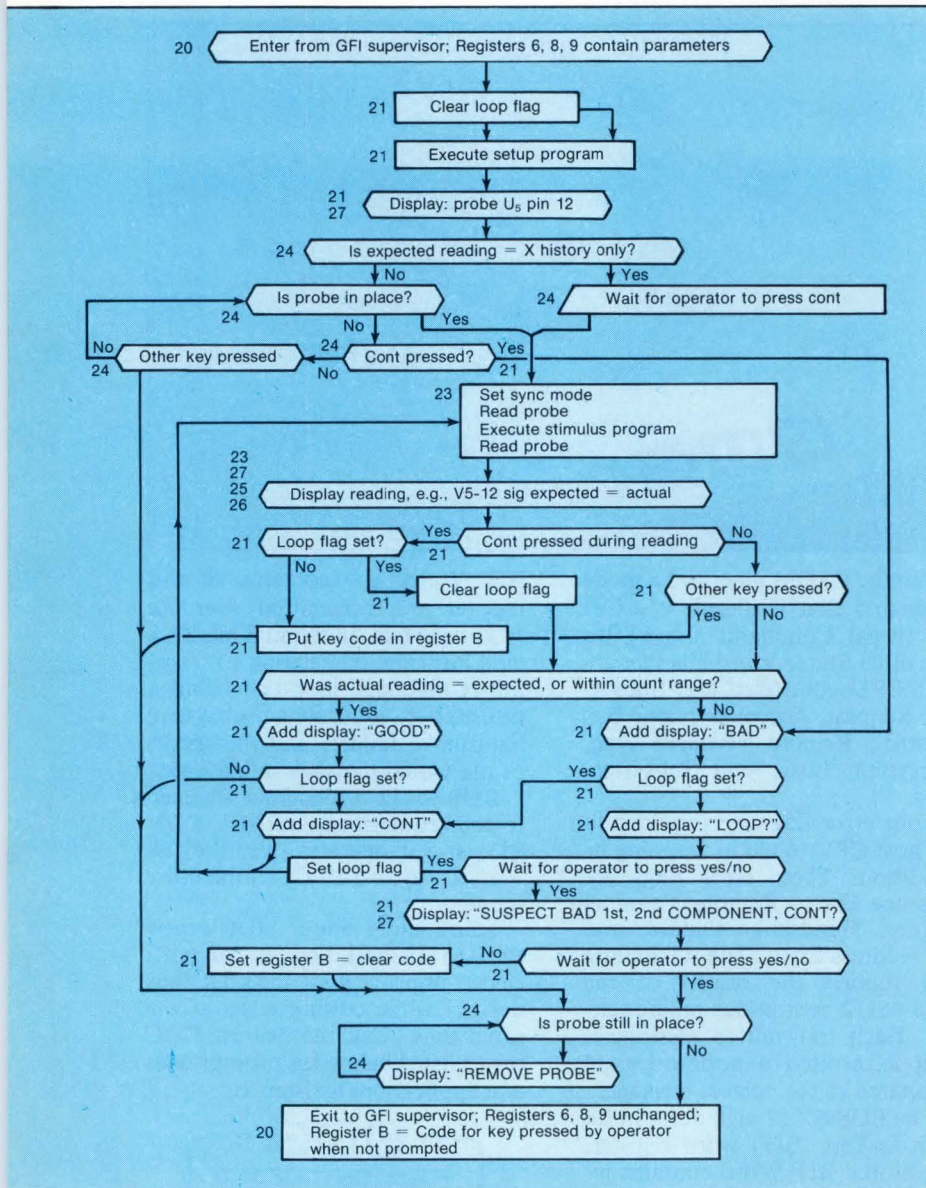
A key element in the diagnostic process is the user interface that permits testing to begin with a few keystrokes. For example, the keyboard of the ET-2000 (Fig. 3) is broken down into three categories: program functions; system functions (including a hexadecimal keypad for data entry); and command functions, such as tests for shorts, RAM and ROM.

The unit's unique signal identification mode lets the user probe traces on a circuit board and displays the identity of the line and its logic state (e.g., "Address Line 6 Floating"). An optional voice unit gives the user that information aloud, allowing the diagnostician to concentrate on following the circuit traces.

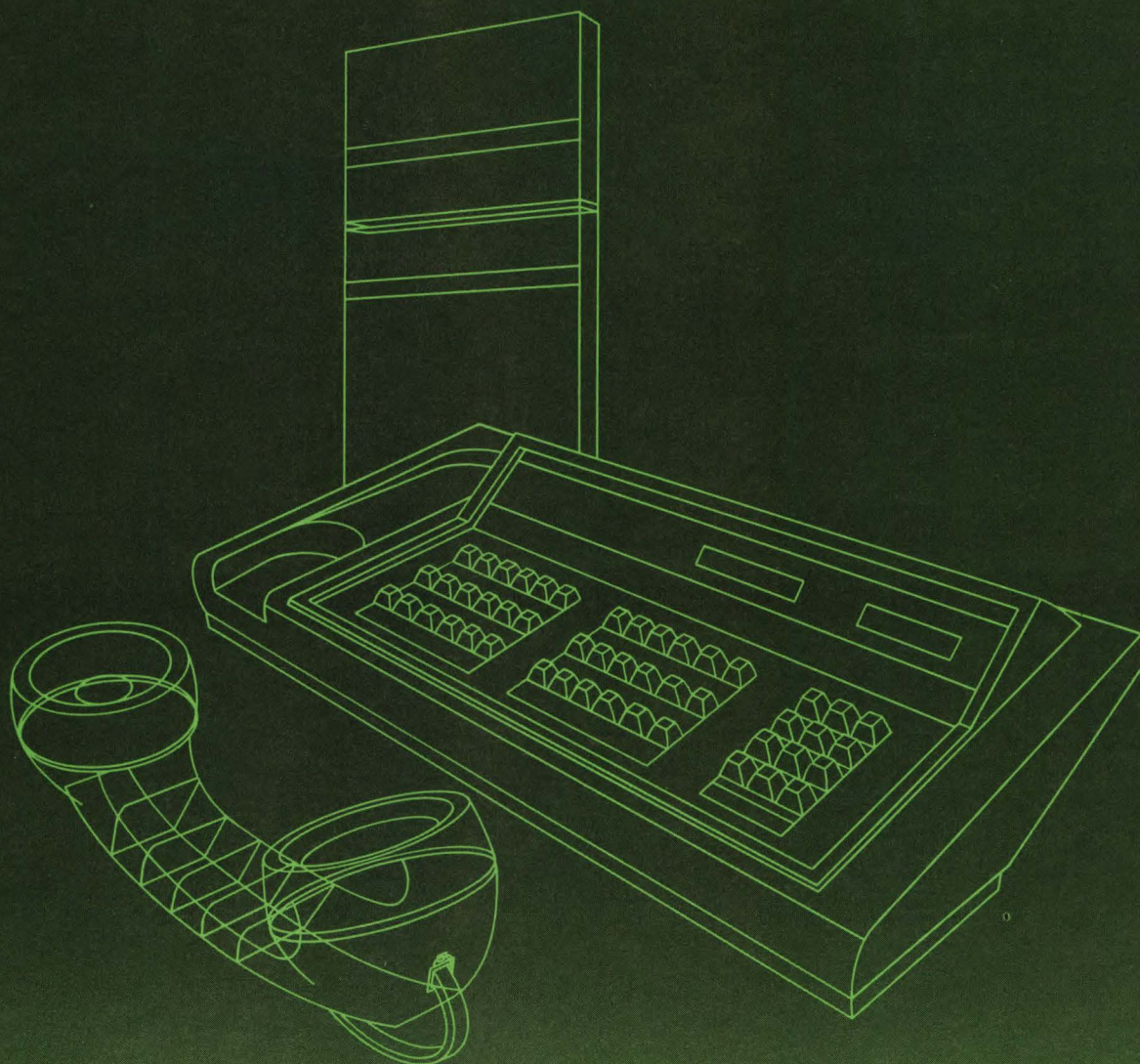
If the kernel passes all the tests, the user can be confident that its circuitry is operating properly. For examining the unique hardware area beyond the kernel, both testers have logic probes and signature analysis tools that can be called into play.

Just as important, a whole sequence of tests—both built-in and user-defined—can be brought to bear on a problem.

One of the benefits of this technique is that it guides service personnel through a troubleshooting path. A guided fault isolation program for the 9010A, for instance, directs a user to the proper location by showing a series of instructions on the unit's alphanumeric display (Fig. 4). □



4. Before the introduction of specialized microprocessor-system troubleshooters, guided fault isolation (GFI) programs were the province of expensive ATE systems. In a GFI flowchart for the Fluke 9010A, prompts to the operator appear after the word "display" in the various boxes. The numbers beside the boxes are the performing program numbers.



Transient protection ...for today and tomorrow.

If you're currently designing telecommunication systems, we have TransZorb® transient voltage suppressors to meet all your requirements... for today and tomorrow. And, if your systems must meet industry requirements (FCC, REA, CCITT), we can help you meet them reliably and cost effectively. For transient solutions for your advanced

designs... look to the leader. We're working on tomorrow's designs today, and have been for 16 years. Call or write for design assistance, or for a copy of our TransZorb Telecommunication Applications Brochure and Selection Guide Slide Rule.

TransZorb® is a registered trademark of General Semiconductor Industries, Inc.

*Transient Protection
With A Solid Reputation™*



**General
Semiconductor
Industries, Inc.**

SQUARE D COMPANY

**WHEN IT COMES
TO COMPLETE,
PORTABLE
IN-CIRCUIT
EMULATORS...**



SOPHIA SYSTEMS STANDS ALONE.

Now you can emulate without a host, target, or other add-on systems. Sophia SA700 personal and portable emulators for Z80™, 8085, 8086, 8087 and 8088 give you powerful, standalone micro development and debugging for less than \$10,000. Nothing else compares.

Our disk-based emulators are floppy compatible with Intel Series II/III (ISIS), System 86/330 (iRMX86™), CP/M and CP/M-86™ systems. Plus with our serial link, you can easily connect hosts such as DEC VAX®-11 or IBM® PC, and download to our floppy disk for debug, storage, and program re-entry. Dramatically saving setup time.

The result? Sophia's SA700 in-circuit emulators free up the host for software development and cut

development time. You no longer have to wait for host availability. The SA700 is always available and goes anywhere—lab, office, customer site, or even home for the weekend.

An international market leader of in-circuit emulators, Sophia Systems has delivered more than 3,000 SA700 systems worldwide since 1982. Each system comes with an extensive support program, including a one-year limited warranty, and is backed by our regional service centers.

In the rush to get your designs to market, Sophia's SA700 in-circuit emulators stand alone. Call or write today for a demonstration and further information. Sophia Computer Systems, Inc., 3337 Kifer Road, Santa Clara, CA 95051, (408) 733-1571.

STANDARD FEATURES:

- Integrated floppy, CRT, keyboard & ICE™ probe
- Built-in PROM programmer
- Serial, parallel & external ports
- Real-time trace, timing & emulation
- Logic analysis
- Multiple hardware breakpoints—CPU, memory, bus, external states
- Emulation RAM—up to 316Kb standard
- Single/multiple step execution
- Full symbolic support—break, trace, (dis)assemble, display
- Macro command language
- Proprietary & CP/M® operating systems
- Full-screen editor
- Extensive documentation & design aids



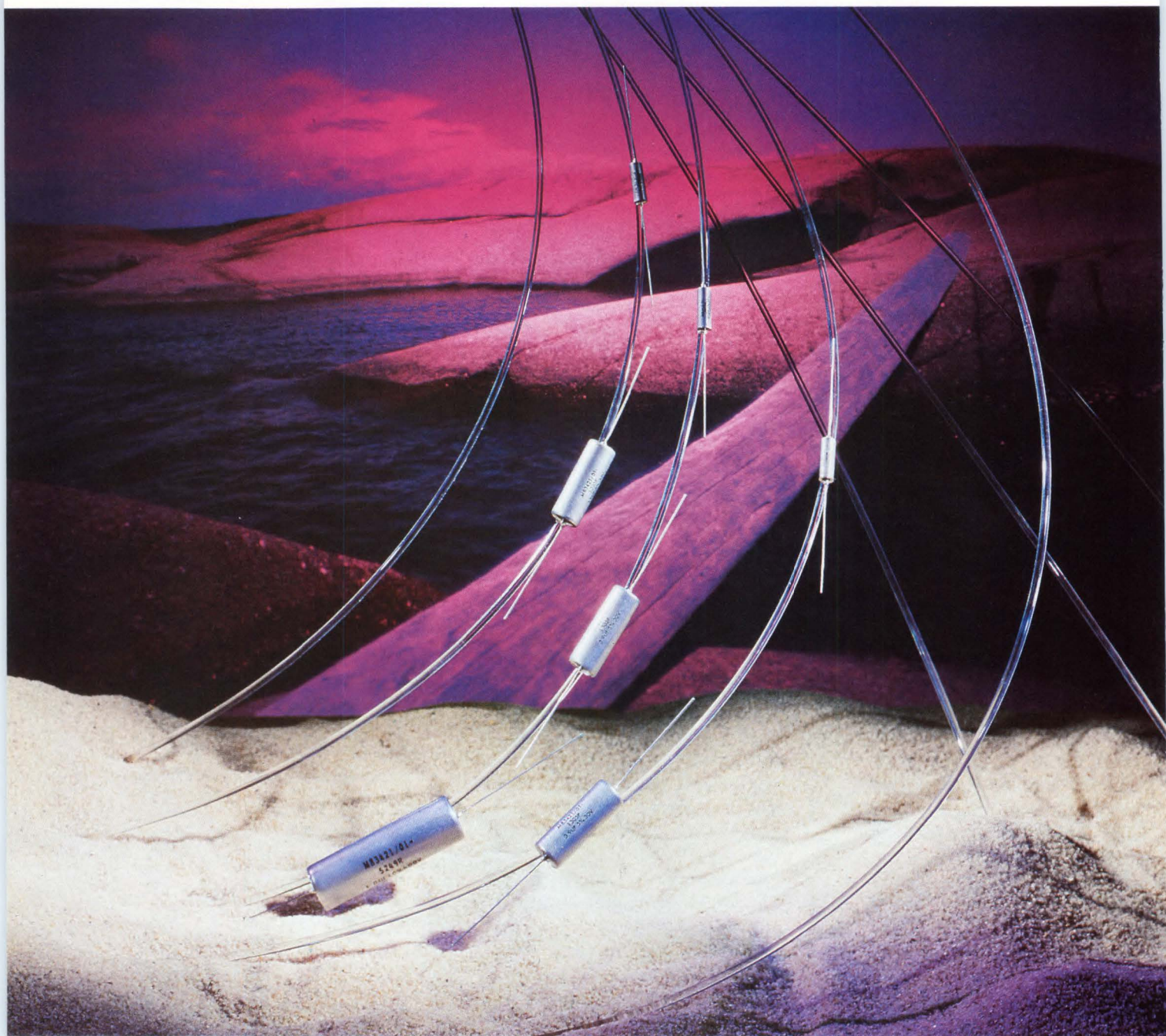
"SEE US AT WESCON BOOTH 1029"

Sophia
systems™

**HELPING TO BRING YOUR
DESIGNS TO MARKET FASTER.**

©1984 Sophia Computer Systems, Inc. Sophia Systems is a trademark of Sophia Computer Systems, Inc. CP/M is a registered trademark and CP/M-86 is a trademark of Digital Research, Inc. ICE and iRMX86 are trademarks of Intel Corporation. Z80 is a trademark of Zilog, Inc. VAX is a registered trademark of Digital Equipment Corporation. IBM is a registered trademark of International Business Machines Corporation.

1000s OF MISSIONS.



4SD-4101

SPRAGUE CAPACITORS WITH 'S' LEVEL APPROVAL.

hours in military aircraft. Competitively priced, they're available through the nationwide network of Sprague Distributors. Voltage ratings from 30 to 400 VDC. Capacitance values from 0.001 to 22 μ F. Write for Engineering Bulletin 2712.1 to Technical Literature Service, Sprague Electric Company, a Penn Central unit, 347 Marshall St., North Adams, Mass. 01247.

Sprague MIL Style CRH01 thru CRH05 Metallized Polycarbonate Capacitors are manufactured by the Dearborn Electronics Division of Sprague Electric to meet Military Specification MIL-C-83421/01. These hermetically-sealed, axial-lead units have 'S' level approval which is based on more than 230,000,000 unit-hours with zero failures. On a real-time basis, they've also logged millions of capacitor

SPRAGUE
THE MARK OF RELIABILITY

CIRCLE 42

VIEWPOINT

To think for themselves, computers must first learn some common sense

John McDermott

Cofounder
Carnegie Group Inc.
Pittsburgh, Pa.

Today's artificial-intelligence systems are on the right track and moving full tilt toward truly achieving the ability to think." So asserts John McDermott, one of the early leaders in creating AI systems. He affirms with equal certainty: "No monumental breakthroughs will be required." The only technological challenge in building expert systems is making them smarter without having them "outsmart" themselves.

Adding to an expert system's store of knowledge is difficult, McDermott concedes. "As a system becomes more sophisticated, the demands on it increase as well. Eventually it encounters situations about which it has no knowledge, so more rules have to be added."

Unlike their human counterparts, intelligent computers are not aware of their own limitations. Consequently,

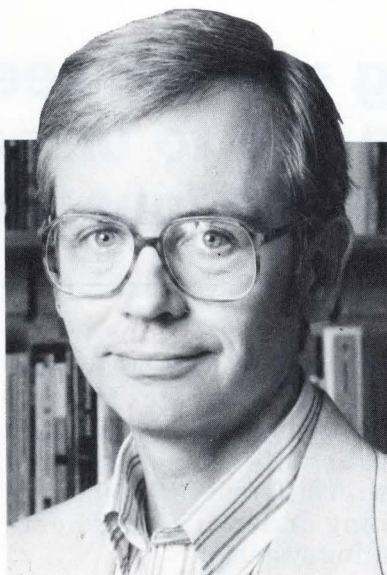
they do not shy away from situations in which they lack the requisite competence. And, he continues, "they do not have a trait that many human beings take for granted—common sense."

Simultaneously, adding the needed rules to an expert system can frequently result in a

computer that—so to speak—falls over its own feet. Theoretically, each rule defines the situation in which it can be applied, and supplementing an AI system's knowledge simply involves defining a new rule and adding it to the system. Still speaking theoretically, McDermott notes that rules should not interact negatively. In reality, though, they often do.

"You can almost never specify a sequence of even two or three steps." At each—depending on the situation—there might be four, five, or six different alternatives to choose from, resulting in confusions and ambiguities caused by overlapping descriptions. The programmer never quite knows which rule will fire, and when one does, it may perform some action that violates another rule.

The problem of knowledge acquisition, McDermott projects, must be addressed in the long term if we are to see systems that can truly learn. "I think that over the next two to three years, the tools will be developed to assist programmers in adding knowledge to an AI system." Over the longer run, he believes, systems will evolve that will



John McDermott, the associate head of the Computer Science Department at Carnegie-Mellon University (Pittsburgh), is a pioneer in the research and development of expert systems. He is one of four AI experts who recently formed the Carnegie Group. McDermott holds a PhD from the University of Notre Dame.

Carole Patton

VIEWPOINT

be capable of recognizing inadequacies in their own behavior.

Alternatively, told that they did something wrong, they will infer what information they need, create it, and go on about their business. "They are clearly going to have to gain some reasoning ability," he says.

For McDermott that is not a problem. "Computers will develop common sense in the same way that people do—as a result of absorbing and storing increasing amounts of information. That ability, he thinks, will be enhanced as computers acquire sensing abilities that will enable them

to collect data, recognize regularities in it, and form their own sets of rules and generalizations. Such sensors can be thought of as comparable with the "eyes and ears" of a robot.

McDermott stresses an important point: AI researchers are not out to mimic human intelligence. "People interested in expert systems do not care whether the mechanisms they create use the same thought processes that humans do. Rather, they are interested in results. The process for achieving them does not matter."

The broader issue remains how to get a system to display

common sense. "Only when a computer can gain an understanding of what the world is like through wide-ranging 'experiences' can it learn what it can and cannot do."

"From what we know today," McDermott concludes, "and from my analysis of what it will take to realize truly intelligent systems, I see thinking computers within the next 10 years." Though not all computers may be Mensa members by then, the idea that some might qualify does not bother McDermott. "I will be completely at home in a world where much of the intelligence is silicon-based."

Bridging gap between hosts is the key to unlocking communications software

Howard Gordon

President
Network Research Corp.
Los Angeles, Calif.

Designers seeking a solution to the communications software problem," declares Howard Gordon, "are looking in the wrong direction." The true challenge is not how to drive a communications controller or establish handshaking cir-

Ray Weiss

cuitry, but how to create software that bridges the gulf between various host environments—"ones working with different CPUs and running under different operating systems."

Such software, he continues, must transfer data between dissimilar entities yet ensure that the information remains usable. Further, the package must establish some common ground (or functions) between seemingly incompatible host computers so that they can share the

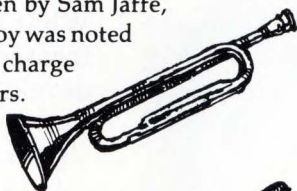
load while each is working on a particular application. Once that is accomplished, Gordon maintains, we will see programs that run on diverse machines and under operating systems that employ different communication protocols and hardware.

"The only way to reach that point is by introducing abstractions into the communications software." For example, instead of coding a program for a specific interface, it is more effective to design that program for a

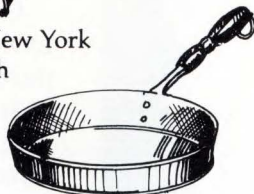
TAKE THE DIN QUIZ!

How Much Do You Really Know About DIN?

1 Immortalized in poetry by Rudyard Kipling, and portrayed on the screen by Sam Jaffe, this famous Indian water boy was noted for his courage during the charge of the British Sepoy Lancers.



2 Name the famous district in New York City commonly associated with musicians and composers.



3 Name the powerful, 1958 Tennessee Williams drama in which Elizabeth Taylor wore fetching slips, Paul Newman's pajamas matched his eyes, and Big Daddy Burl Ives looked sweaty in a rumpled white suit.



4 During the 50s and 60s, a warmhearted tale of a boy and his dog captured the hearts of television audiences. Name the dog who assisted in maintaining law and order in the early west.



5 Name the popular Dashiell Hammett novel which was made into a movie starring William Powell, as the ultimate nonchalant criminologist and Myrna Loy, as his trouble-prone wife.



6 In this famous 1967 movie, two diverse families sit down face to face to consider a rather unsettling situation. Starring Sidney Poitier, this urbane and stylish comedy was Spencer Tracey's last movie.

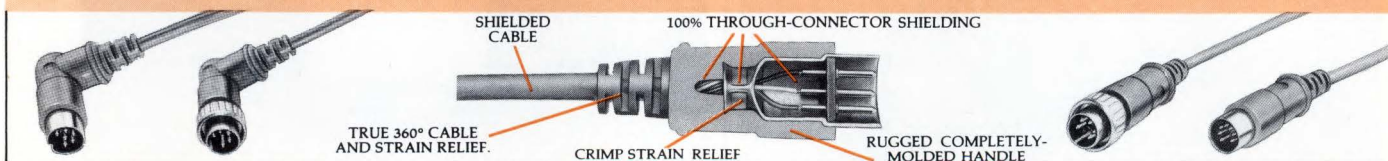


Answers to Quiz:

1) Gunga Din, 2) Din Pan Alley, 3) Cat on a Hot Tin Roof, 4) Rin Din Din, 5) The Thin Man, 6) Guess Who's Coming to Dinner.

If you answered any or all of the above questions, you definitely qualify for Switchcraft DIN Connector and Cable literature and samples. Fill in the coupon below, or if you can't wait a moment longer, call Mr. Dean Arvantis at (312) 792-2700, our DIN expert.

Some famous facts about Switchcraft DIN connectors and cables



FACT: SWITCHCRAFT CUSTOMIZES. Switchcraft can make exactly what you need when you need it. Whether it's color, wire size, type of shielding, or molding in your company logo—Switchcraft has complete custom design capabilities to match your equipment or define your corporate identity.

FACT: SWITCHCRAFT CONNECTORS—QUALITY TESTED. Switchcraft's shielded connectors are effective ways to make your computers comply with the FCC's Electro-Magnetic Interference (EMI) regulations. Fully address FCC 29780 Docket.

FACT: SWITCHCRAFT SHIELDED CONNECTORS ARE DESIGNED TO CONTROL INTERFERENCE. Switchcraft shielded connectors will "bleed off" EMI/FRI—virtually eliminating annoying glitches, memory loss or possible damage to CPU components.

FACT: SWITCHCRAFT OFFERS A LARGE SELECTION OF CONNECTORS AND CABLES. Switchcraft offers a broad line of DIN Connectors/Receptacles/Cables; male-female, straight or right angle, push-on or locking, 8 different pin/contact configurations. Plus, an exclusive one piece shield design reduces costly assembly.

FACT: SWITCHCRAFT DESIGNS REDUCE CABLE FATIGUE AND WIRE FRACTURING. Four-way flex relief relieves strain in up/down or side to side motion.

FACT: SWITCHCRAFT PROVIDES THE OPTIMUM SOLUTION TO YOUR SPECIFIC DIN CONNECTOR AND CABLE DESIGN REQUIREMENTS.

☐ Yes, I passed the DIN QUIZ.

Please send me literature/samples.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

SWITCHCRAFT INC.

A Raytheon Company

5555 N. Elston Ave., Chicago, Illinois 60630
(312) 792-2700

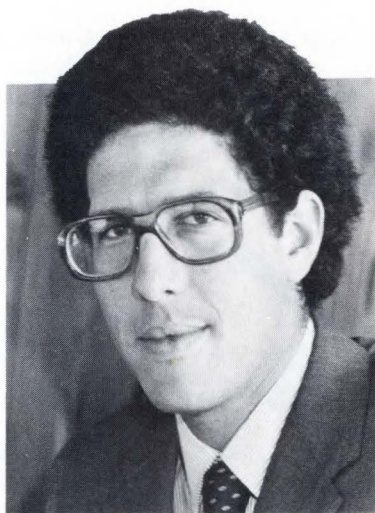
VIEWPOINT

general interface. Tables referenced by the code can then tailor the program for the target interface.

Employing a table to define the interface introduces what is known as a level of indirection, equivalent to that called into play when indirectly addressing a computer. The approach would allow the same code to handle different interfaces (simply change the table entries) and will be needed at the device, protocol, and operating system levels.

"Thus," states Gordon, "the communications problem actually involves building sufficiently high-level software."

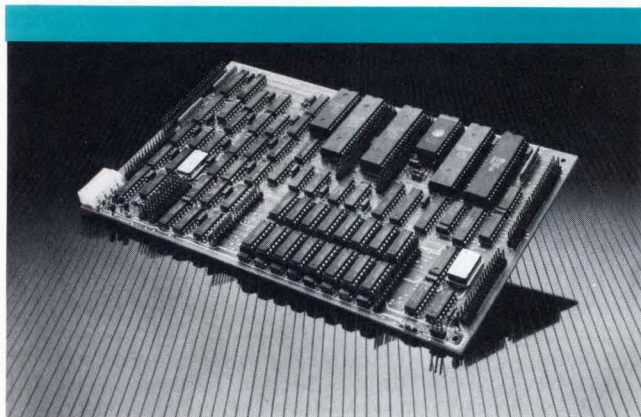
Consequently, the activities in communications soft-



Howard Gordon founded Network Research early in 1982. Before starting the company, he served as an industry consultant on software for minicomputers and micros, as well as on diagnostic programs.

ware should shift from developing host-specific programs. What is needed is an effort focused on creating software-development methodologies and tool sets that are designed for diverse hosts.

Gordon also foresees "the arrival of truly transportable development tool sets." These would comprise portable compilers and linkers, generalized operating system interfaces, and a core communications processor that can be set up for any communications technology. With proper tools and methodologies, Gordon concludes, the true communications problem—incompatibility—will be easily remedied. □



POWER THAT GOES ANYWHERE!

Single Board Computer

- | | |
|-----------------|--------------------------------------|
| FAST | — 6MHz Z80B® CPU |
| POWERFUL | — 64K to 256K RAM, 2K to 64K ROM |
| | — 5¼" and 8" Floppy Controller, SASI |
| | — 2 RS-232, Centronics Port |
| FLEXIBLE | — 50-pin I/O Expansion Bus. |
| SMALL | — 5¼" x 10" |

Davidge

DAVIDGE CORPORATION
292 East Highway 246
P.O. Box 1869
Buellton, CA 93427

(805) 688-9598

*Z80 is a registered trademark of Zilog

CIRCLE 44



Now Standex makes it easy *and* economical to comply with the latest FCC noise pollution requirements. One of our new power line filters will do it. Select from over 150 models in 15 different series plus customs and military designs.

Standex offers a competitive edge:

- Premium quality components
- Strict quality control standards
- Over 40 years of experience with inductors and capacitors
- Direct replacements for most standard filters
- Capability to meet rigid military specifications
- U.L. recognized, CSA Certified, VDE pending

Write or call for your latest data sheets for EMI/RFI filters.

Standex Electronics

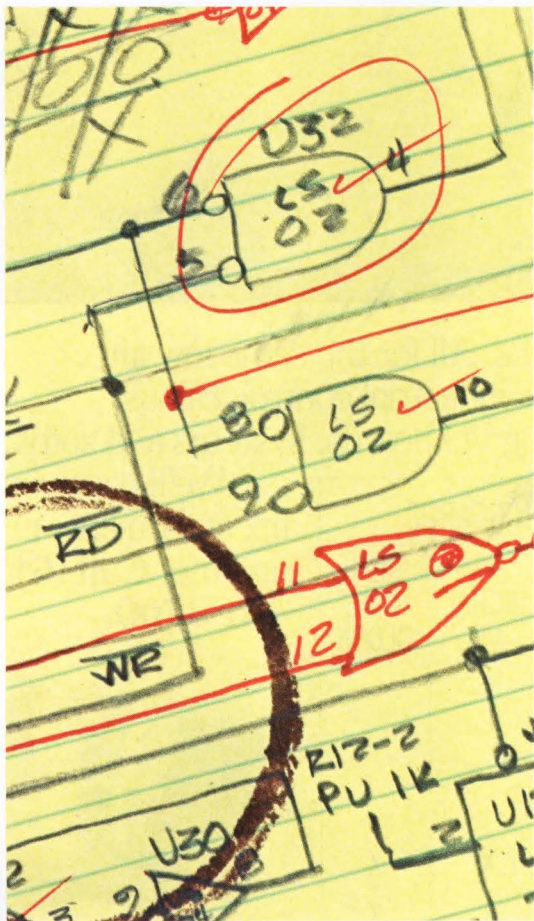
4538 Camberwell Road, Cincinnati, Ohio 45209
Morley Road, Tonbridge, Kent, England TN11 9JL

Standex company

"SEE US AT WESCON 1378"

CIRCLE 45

DON'T WASTE YOUR TIME ON SEMICUSTOM.



Let's face it. Your logic diagram is just one big doodle if your semicustom vendor can't take it and turn it into silicon fast.

With Mostek, you won't have time to waste. We have the design tools, technical assistance, and manufacturing muscle needed to quickly take you from concept to completion.

For example, our Semicustom Design Centers give you access to extensive libraries of gate arrays and standard cells. And our Highland 2SM design automation system is easy to learn and use.

You can select gate arrays up to 10,000 gates. Standard cell libraries at your disposal will include analog, RAM, ROM, and PLA's. All implemented in double level metal CMOS with performance down to 1.5 ns per gate.

Before you know it, you'll be creating system level designs from our precharacterized macrocells with the confidence that comes from guaranteed performance. And you can count on Mostek performance as well.

During your design phase, our staff is available to answer any questions you have regarding Highland 2, the cell libraries, testing or packaging. Then Mostek's extensive production facilities will take you and your design smoothly through prototyping and manufacturing.

We have a comprehensive second source agreement with Gould/AMI, so you can be confident of support at every stage of the process.

The final result? You save time, trouble, and can lower the cost of new product development. Stop wasting your time. Contact Mostek Corporation, 1215 W. Crosby Road, MS2205, Carrollton, Texas 75006, or call (214) 466-6000. In Europe, call (32) 02/762.18.80. In Japan, 03/496-4221. In the Far East (Hong Kong), 5-681157.

Highland 2 is a service mark of Mostek Corporation.



"Looking for bus compatible data acquisition boards? You've come to the right guy."

Left to right, Fred Molinari, President

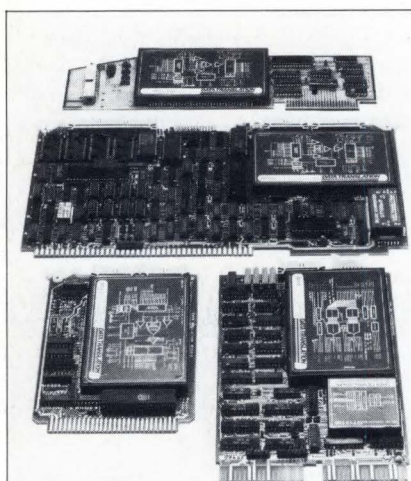
This isn't just a line.
Data Translation offers the most complete line of analog I/O boards available. Anywhere.

We have LSI-11[™] Bus, MULTIBUS[™], UNIBUS[™], IBM PC[™] Bus, STD Bus, and Apple[™] Bus. You'll never have to change buses to get the analog compatibility you need.

And you won't be left stranded for help ...our user manuals and thorough diagnostics guide you through any technical road blocks. All for the same low fare.

So whether you're in scientific research or industrial control, call us.

We're the world's leading supplier of analog I/O boards, systems and software.



Data Translation is the leading supplier of microcomputer compatible analog I/O boards.

DATA ACQUISITION BOARDS

BUS	A/D	D/A	DIGITAL I/O	REAL TIME CLOCK
STD	X	X		
MULTIBUS	X	X		
UNIBUS	X	X		
LSI-11	X	X	X	X
IBM PC	X	X	X	X
APPLE II	X			

We'll have you up, and on line, in no time. Call (617) 481-3700.



See our 192 pg. new product supplement in Gold Book 1984, Vol. III, and our 336 pg. catalog/handbook in Gold Book 1983.

DATA TRANSLATION

World Headquarters: Data Translation, Inc., 100 Locke Dr., Marlboro, MA 01752 (617) 481-3700 Tlx 951-646.

European Headquarters: Data Translation, Ltd., 430 Bath Rd., Slough, Berkshire SL1 6BB England (06286) 3412 Tlx 849-862.

LSI-11 and UNIBUS are registered trademarks of Digital Equipment Corp. MULTIBUS is a registered trademark of Intel Corp. IBM PC is a registered trademark of IBM. Apple is a registered trademark of the Apple Computer Corp.

INTERNATIONAL NEWSFRONT

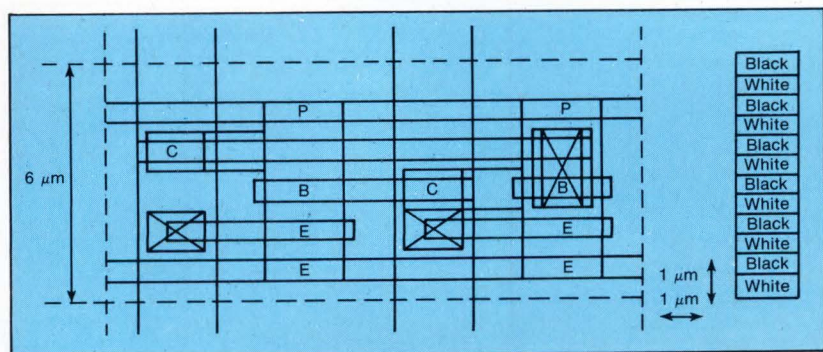
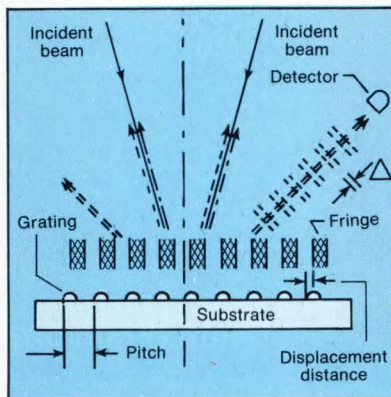
Submicrometer features move into reach with lasers and UV light

Using holography to align patterns, a photolithography system brings resolution to $0.5\text{ }\mu\text{m}$, accuracy to $0.1\text{ }\mu\text{m}$.

The prospect of creating $0.3\text{-}\mu\text{m}$ features on semiconductors waits around the corner, as demonstrated by a laser-based photolithographic system. Although still in the early experimental stages, the system can expose an area of 20 by 20 mm, four times that of today's $10\times$ step-and-repeat systems. Even more important, it works with a resolution of $0.5\text{ }\mu\text{m}$ and aligns patterns with $0.1\text{ }\mu\text{m}$ accuracy.

Matsushita Electric Industrial Co. Ltd. (Osaka, Japan) combines a helium-cadmium laser ($\lambda = 441.6\text{ nm}$) that produces a holographic fringe pattern with conventional ultraviolet-light lithography. Using the holographic fringe pattern as a reference, 0.3- to $1\text{-}\mu\text{m}$ lines and spaces can be formed. Two laser beams hit an alignment grating built into the wafer, diffract, and form a holographic fringe pattern (see the fig., top). The substrate grating is formed using $1\text{-}\mu\text{m}$ lines and spaces

that are fabricated in the wafer's scribed regions using standard photolithographic exposure and subsequent



A holographic fringe pattern (top) is used in a photolithographic process to create $0.5\text{ }\mu\text{m}$ patterns with an alignment accuracy of $0.1\text{ }\mu\text{m}$. Taking advantage of this technique is a reorganized six-transistor ECL memory cell (bottom).

etching.

The grating and holographic fringe thus set up a double reference point for alignment and exposure control. But to take full advantage of the system, circuit layout practices must be modified.

In a six-transistor ECL memory cell (see the fig., bottom), designed at Matsushita, the $0.5\text{-}\mu\text{m}$ base and emitter stripes are formed in the horizontal direction with holographic techniques and the $1\text{-}\mu\text{m}$ features are created vertically through UV lithography. One holographic lithography step creates the base-emitter isolation and another forms the first layer of aluminum for wiring. UV lithography takes care of the cell's peripheral circuitry.

With this technique, Matsushita can bring the ECL cell in at 6 by $13.5\text{ }\mu\text{m}$ —not much larger than the lone transistor and capacitor cells found in experimental 1-Mbit dynamic RAMs. □

Dave Bursky

SEE WHAT YOU'VE BEEN MISSING!

DIGITAL WAVEFORM TRANSIENT RECORDER

When The Application Demands . . .

Precise multichannel recording, the SMR2 comes through.

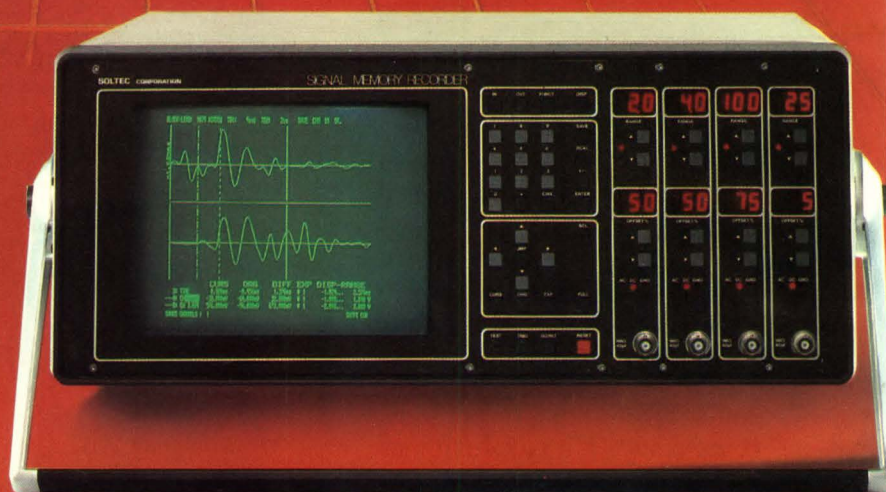
Excellent for data collection of SHOCK, VIBRATION, STRESS and STRAIN.

SMR2 enables tape drive users to do "quick look" analysis of recorded information.

SMR2 is ideal for multichannel recording of any non-recurring event, i.e. ballistics, explosives and destructive testing.

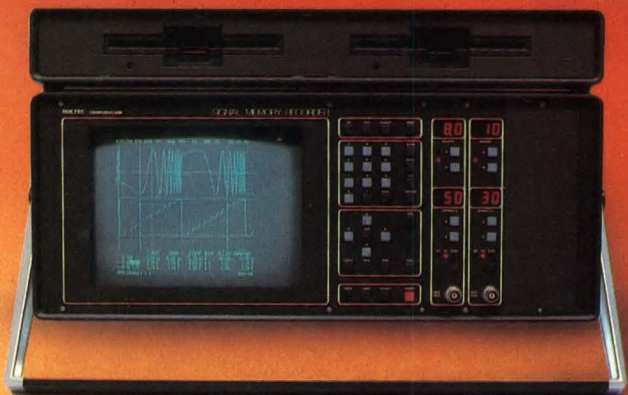
And for "babysitting" of power line monitoring you can rely on the SMR2 . . . plus much, much more

- **MORE CHANNELS**
... UP TO 16
- **MORE MEMORY**
... UP TO 64K PER CHANNEL
- **MORE CAPABILITY**
MULTICHANNEL STORAGE,
ANALYSIS AND DISPLAY



When things are happening fast . . .

The SMR2 will monitor, capture, measure and analyze transients that range from DC to 2.5 MHz, together with the conditions that existed prior to and after the event. It will display this data with an alphanumeric tabulation of its parameters and output it for hard copy or further digital processing. It will transmit data over standard serial or parallel busses or store it off-line for interchange, archival, or future reference. It will call the data back for direct comparison to subsequent events and display these events with common or independent triggers. The SMR2 can be expanded to a 16 channel recorder complete with a CPM 2-2 operating system and standard software packages. SMR2's modular design allows it to be configured for a wide range of high speed recording applications.



**For complete details
or a demonstration
CALL**

SOLTEC®
CORPORATION

11684 PENDLETON STREET • SUN VALLEY, CA 91352

IN CALIF. (818) 767-0044

OUTSIDE
CALIFORNIA **800-423-2344**

CIRCLE 52

INTERNATIONAL NEWS ANALYSIS

On the European front, silicon compilers focus on design languages

Increasingly complex chip circuitry means that silicon compilers must master higher-level design languages.

Not unlike their counterparts throughout the balance of the world, researchers in European industry and in universities are looking toward silicon compilers to design and build the next generation of VLSI circuits. A great deal of the effort is directed to creating high-level descriptive languages for circuit entry. The push is also on for techniques to integrate simulation, automate layout and routing routines, generate test patterns, and prepare masks directly from design-entry software.

Schematic entry techniques are the most familiar to engineers and have thus been the method of choice for CAE systems employed in designing standard cells and gate arrays, at least when only a few thousand gates are involved. For more complex circuits, however, higher-level descriptions are mandated.

Although a language such as Pascal can be used to enter

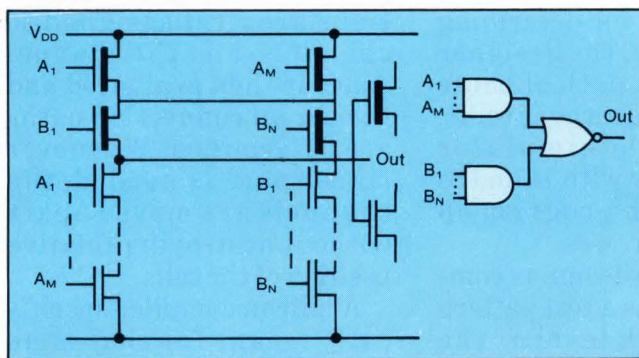
a logic description, it is not suited to linking the circuit connections and algebraic descriptions. That shortcoming has led to special-purpose languages, such as Model, which allow a hierarchical circuit design to be represented in a computer program. Complex structures may be defined in the language, from Lattice Logic Ltd. (Edinburgh, Scotland), using simpler components. The system library consists of standard parts that are logically similar to basic TTL gates (Fig. 1). Model makes

use of program-structuring statements such as "if . . . then, else-end if," and repetitive "while," "until," and "for" instructions.

In operation, a circuit is compiled in an intermediate design language that is equivalent to a net list. The compiler checks for syntactical errors (e.g., incorrectly formed statements) and structural problems (unconnected inputs and outputs or shorted nets). It also performs simple optimizations by stripping out redundant circuit elements.

The next step up in hierarchical construction can be seen in a hardware-design language targeted for fully custom cells, as well as for standard cells and gate arrays. It runs on a VAX machine operating under the VMS operating system and is currently designing and simulating circuits comprising up to 100,000 gate equivalents.

Ella, which borrows many



1. In Lattice Logic's descriptive language, called Model, an ANDNOR function can be described as a circuit (left), as a logic diagram (right), or as a part definition
`andnor(m,n) [a(l:m),b(l:n)]→out.`

Mitch Beedie

INTERNATIONAL NEWS ANALYSIS

of the design ideas used by other high-level languages, like Pascal, is a textual hardware description language that enables all the levels of a hierarchical design to be simulated from the top down. Developed by the Royal Signals and Radar Establishment (Malvern, Wores., England), the language has a standard library of parts. Its main strength lies in its flexibility; it allows a designer to specify a chip's architecture, an important factor in broadening the system's range of applications. The designer can also define signal values, as well as set the delays between inputs and outputs. Further, the engineer can specify basic logic gates—two-state, three-state, and so forth.

Part of the program

Timing information must be entered in the designer's program, and when complete, the program is compiled to produce a file that is a compact network description. Ella simulates the circuit design by permitting various values to be entered. By using an algorithm for describing device delays, the designer can trace the path of these values through the circuit. Moreover, the simulator works not only with 1s and 0s but also with program op codes and addresses.

Once a chip design is complete, Ella runs a test pattern through each level of the simulation: if the same result is obtained at each of the levels, the design is judged sound. The verified network

description is then transferred to the host computer for layout and routing.

A high-level structural design language, devised by scientists at the University of Newcastle upon Tyne (England), breaks a design down into cells at the various hierarchical levels. It represents another approach to silicon compilers. STRICT, for strongly typed recursive integrated circuit, describes cells in terms of yet smaller cells. Those, in turn, are broken down into even smaller cells, and primitives, or both.

After the initial functional simulation, the cells are placed by the system, with the designer detailing the circuit organization if cell placement is critical to performance. Cell positioning is loose rather than absolute and is expressed by a cell's relative position to another (left or right, above or below). A horizontal or vertical channel thus runs between any two cells.

Clearing the way

The actual routing takes place in two stages. Connections are first assigned to channels, and the channel space is then evaluated and the actual connection paths are determined. Whenever more space is needed, the channels are moved apart without destroying relative position of the cells.

A silicon compiler specifically meant for real-time digital signal processing produces bit-serial signal-processing chips. Dubbed FIRST, it consists of a library of high-

level hardware operators such as multipliers, adders, dividers, and so forth (Fig. 2).

Developed by the University of Edinburgh (Scotland), the library contains a mix of dynamic and static logic, going with the dynamic techniques when they yield a significant increase in speed or result in a lower transistor count. FIRST's CMOS operator cells maintain a consistent performance at 20 MHz.

Silicon compilers normally simulate hierarchically (largely to cut down on computer time), with the simulations at the higher and lower levels verified by comparison. The functional description of a microcomputer, for example, may be simulated (at op-code level) in parallel with the gate-level logic. The two are then checked against each other.

Timing is everything

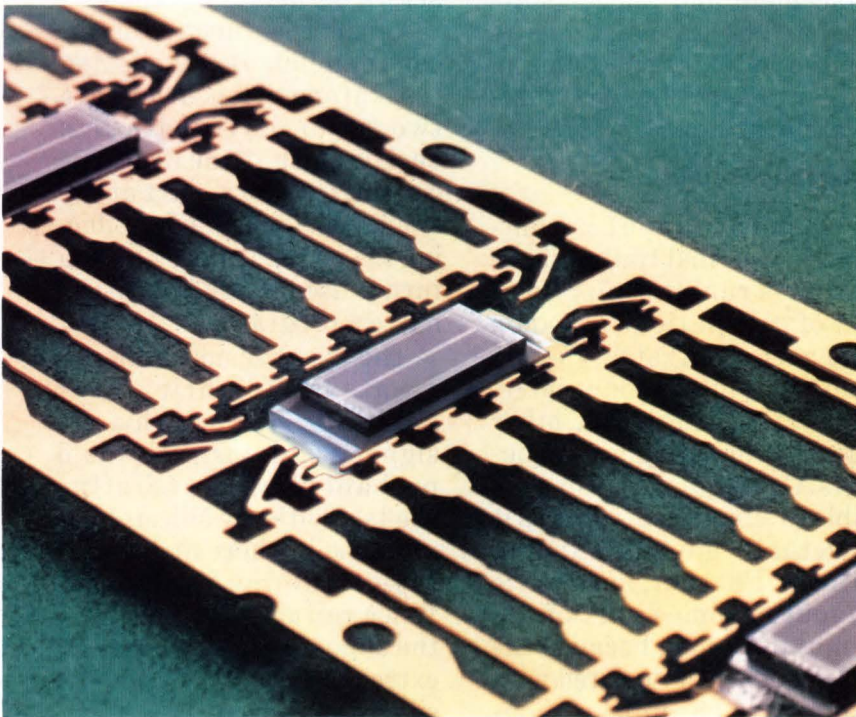
A major aspect of verification, especially in higher-performance circuits, is verifying timing. With silicon compilers, it is not just a question of entering a design into the system and then sitting back and waiting to see if there are any timing problems. The critical factor is not the stability or instability of a signal but whether two signals arrive within acceptable limits so that they mesh correctly with the next circuit. For that reason, timing requirements must be carefully specified in the original logic design.

One silicon compiler carries out four logic-timing simulations. The first pass

Decoupling II

AVX
TechFile Series

TECHNICAL INFORMATION FROM THE LEADER IN MLCs



Decoupling inside the IC package— The new BitGuard™ concept.

AVX's new BitGuard concept places an MLC decoupling capacitor directly under the IC chip—inside the dual-in-line package (figure 1). It offers significant advantages to IC manufacturers, circuit designers and end users. Because of their small size, physical construction and electrical characteristics, multilayer ceramic capacitors (MLCs) are ideally suited for this new space-saving configuration.

BitGuard Advantages

The intimate contact of the BitGuard MLC and the IC chip eliminates the lead and printed wiring inductance normally present between the decoupling capacitor and the IC package (see photo). Lower inductance means improved noise margins, faster speeds and better testability of the IC, all of which contribute to improvements in IC yields and overall performance. In some critical high speed applications, BitGuard may make the difference between a practical circuit design and just another promising idea.

The scope traces of fig. 2 and 3 demonstrate the improvements in decreasing transient noise on a single 2118 (5V) 16K DRAM. Fig. 2 shows

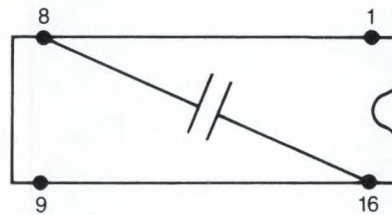


Fig. 1. Schematic showing placement of BitGuard internal decoupling capacitor.

the voltage transients during refresh of a standard part without BitGuard. Fig. 3 shows the transients with a BitGuard capacitor mounted within the IC package between the Vcc and ground.

Additional Benefits

Reduction in interconnections and increased PC board density are additional benefits obtained by including the decoupling capacitor inside of the IC package. Labor is also reduced for inspecting, mounting, and handling capacitors. And BitGuards can often eliminate bulk tantalum capacitors used with large groups of circuits. Although savings will vary with circuit type, system size and complexity, AVX projects that the BitGuard design can typically save up to \$.50 per IC.

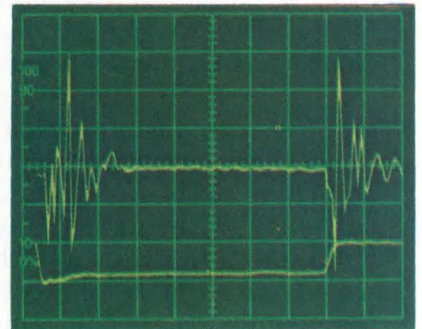


Fig. 2. Voltage transient scope trace of a single standard 2118 configuration with no decoupling capacitor. 50mv/Div.



Fig. 3. Voltage transient scope trace of a single 2118 with BitGuard internal decoupling capacitor. 50mv/Div.

Additional savings are also possible through a reduction in the number of layers required in multilayer boards.

Discussion

The new BitGuard concept promises to improve both the economics and operation of memory, microprocessor and other LSI ICs. For a complete technical paper, send the coupon below.

- ☐ Please send me the AVX Technical paper "BitGuard—A New Concept in Decoupling."
☐ Please send me literature describing AVX MLCs. ED 10/31/84

Name _____

Title _____

Company _____

Address _____

City _____

State _____ Zip _____

Phone _____

Send to: AVX Corporation, P.O. Box 867,
Myrtle Beach, SC 29577

AVX Technology
For The Times

Copyright 1982 AVX Ceramics. AVX, AVX TechFile and BitGuard are trademarks of AVX Ceramics.

INTERNATIONAL NEWS ANALYSIS

uses nominal specifications (unity delays at each gate) to check that the logic is functioning correctly. The second employs the actual logical delays that are worked out according to the fan-ins and fan-outs of the gates. The final go-round works with worst-case logical delays, taking into account chip temperature, supply voltage and current, and the like. The resultant logical data base is a verified and corrected design in the form of a net list.

The compiler was developed by Ferranti Ltd. (Manchester, Lancs., England) in conjunction with Lattice Logic. For that reason, the net list is automatically translated into Model, making it compatible with Lattice's automatic

placement and routing software. The gates are thus placed automatically, taking advantage of the logical hierarchy to do so.

Last time around

Once the layout is completed, the final timing simulation is run. It comprises a set of calculations based on the actual physical delays and takes into account interconnection lengths and other factors, including logical delays. Consequently, it is possible to simulate the chip as it is actually going to exist on silicon. Further, automatic layout becomes part of the simulation loop because the actual delays associated with each gate cannot be accurately calculated until the ex-

act wiring delays are known.

Yet another function of silicon compilers is establishing test information. There are two major parts to testing: verifying that the design is correct (which is part of the simulation loop), and producing the test schedule, which in turn is used to produce the final test program.

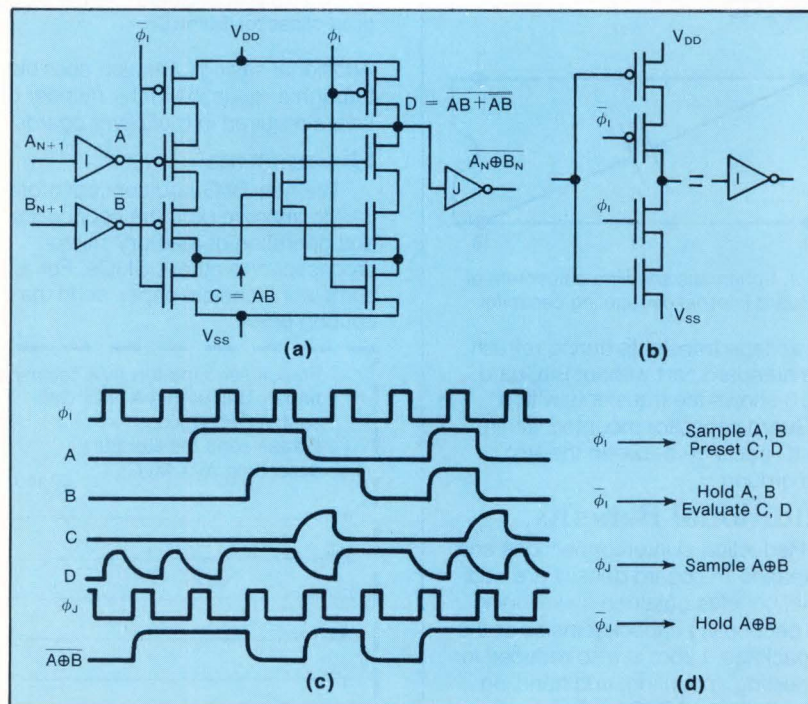
The schedule may either be created automatically or manually. Although a designer's first instinct would probably favor generating the test with the silicon compiler itself, there are advantages to doing it by hand. When run against the logic in the simulator, it furnishes an extra check that the logic design is correct.

Ferranti's compiler, for example, demands that the engineer write the test schedule that supplies the inputs and looks for the required outputs from the circuit. The schedule is run through the simulator to verify that it is correct. Once the schedule is checked, a test program is automatically generated for the various production and development testers.

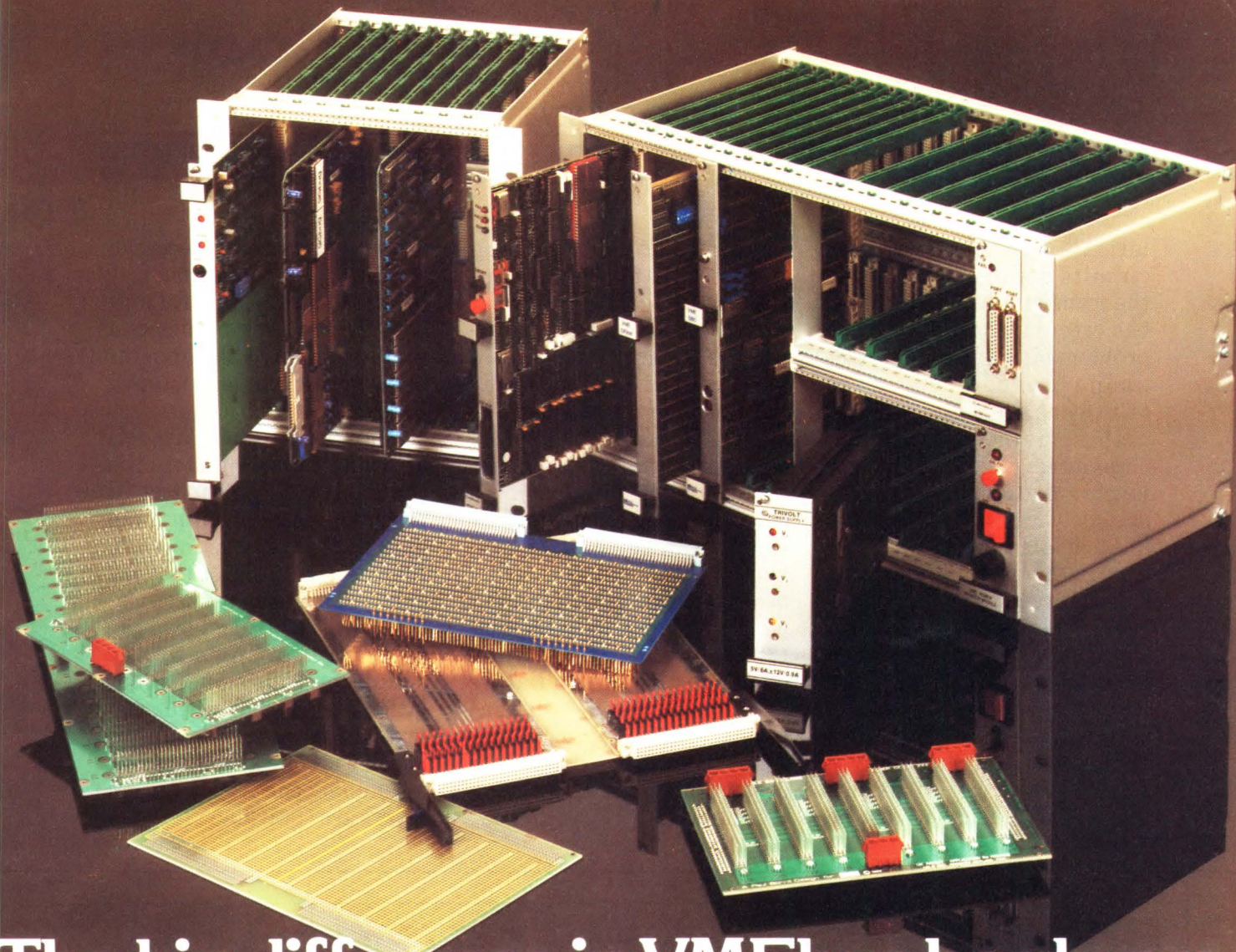
Looking for trouble

Mixing analog and digital circuits on one chip brings its own problems—particularly those associated with critical layout tolerances. The high gains of analog circuits make them exceptionally sensitive to such conditions as drift and offset. In consequence, they must be simulated more thoroughly than their digital counterparts.

Although Spice-like simu-



2. In Edinburgh University's design style, cells are represented in a manner similar to the exclusive-NOR circuit above. The function (a) and the clocked inverter (b) are logically represented while the timing functions are presented relative to the clock cycles (c and d).



The big difference in VMEbus hardware from one company to another is the company.

The VMEbus is making a tremendous impact internationally. Through our involvement, we've learned that all VMEbus products appear to be pretty much alike, but there are important differences.

Take it from us, when you're buying VMEbus equipment you're really buying the manufacturer. His services, standards, prices and promises.

Products can be virtually the same. It's the company that makes the biggest difference. And that's why BICC-Vero hardware is recognized by international companies for its remarkable performance, reliability, precision, and compatibility.

Our extensive inventory and efficiency guarantees you immediate delivery on all VMEbus products. Orders are handled by our world-wide network of subsidiaries and distributors to ensure prompt service and customer satisfaction.

BICC-Vero offers these VMEbus products from stock right now: IEC connectors, prototype boards, backplanes, extender cards, power supply with power monitor module, card frames and front panels.

When you need VMEbus equipment, turn to us.

Our hardware is as fine as anybody's. It's the company that's better.

**BICC-VERO
ELECTRONICS INC.**



A BICC Company

171 Bridge Road
Hauppauge, NY 11788
(516) 234-0400
TWX: (510) 227-8890

TELEPHONE: UNITED KINGDOM (04215) 66300 • FRANCE (4) 402.46.74
• WEST GERMANY (0421) 8 28 18 • SOUTH AFRICA 53-7846/7 • CANADA (613) 384-1142

VME boards supplied courtesy of Mostek, Motorola & Signetics

INTERNATIONAL NEWS ANALYSIS

lation is suitable for analog circuits because it works at the transistor level, the faster the circuit, the greater the problems involved. Bell Telephone Manufacturing Co. (Antwerp, Belgium) for example, mainly works with chips having two interconnect layers—one of metal, the other of polysilicon.

At 30 MHz or so, the difference in the propagation delay time between the two types of material becomes significant. The company's analog silicon compiler thus must be more involved in correcting timing errors than would be a digital compiler. Functional simulation of analog circuits is also difficult and usually must be

simplified by simulating switches rather than transistors.

Bell's silicon compiler accepts both schematic entry and software entry (using Pascal-like statements). The system is again hierarchical, with the high-level architecture being specified using a chip planning program. The input to the system is converted into what is called a neutral network data format, which is connected to the central data base. In addition, logic and circuit simulators are linked to the neutral format. Routing is efficient, taking only 10% to 20% more area than a manually assembled circuit.

One major area of research is functional simulation. It is being studied by several universities and companies as a way of reducing the amount of computer time consumed by logical simulation.

Another problem associated with logical simulation is that it is rarely able to test all possible inputs to a chip. Even once a simulation is finished, there is no guarantee that the chip will perform to specification, only that it meets the criteria laid down by the simulator. Functional simulation aims to employ mathematical transformations to check that the specifications of each of the hierarchical layers are equivalent. □

NEW! No-Snag Fingers for RFI/EMI Shielding

Beryllium copper shielding gaskets engineered for computer applications which must comply with the FCC RFI Interference requirements. NO SNAG FINGERS feature pressure sensitive adhesive mounting or the Tech-Etch "Clip-On" design for fast, reliable assembly.

- Eliminates broken fingers
- Self cleaning contact surfaces
- Special plating available
- Finger width from 3/32"
- Bright standard finish
- Gaps up to 3/16"

Series M

For a free sample, please forward your request on your company letterhead

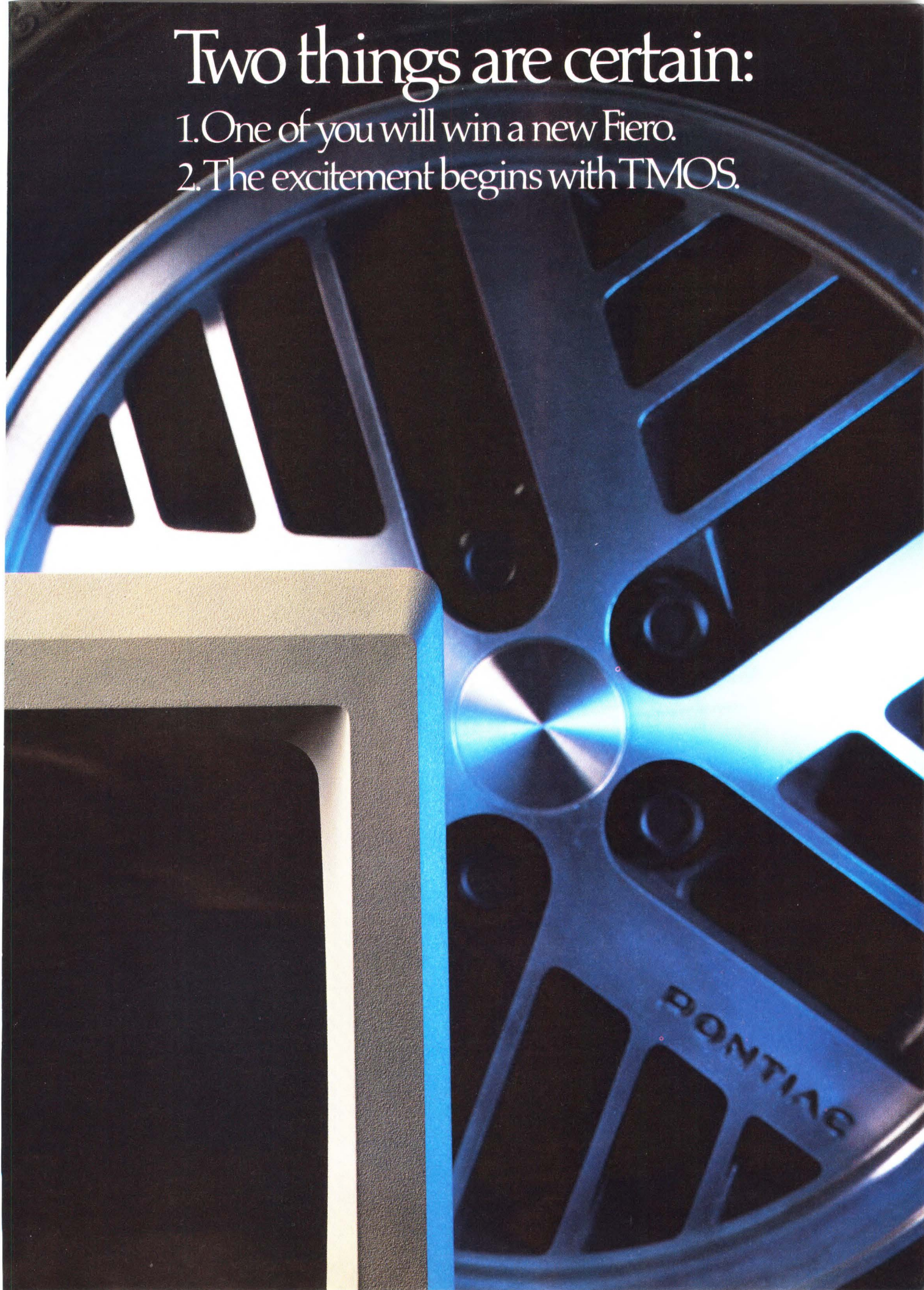
For more than 35 years, the Braun Division of Tech-Etch has been supplying standard and custom designed shielding gaskets to companies in this country and abroad. Always abreast of the latest requirements, Tech-Etch engineers can solve your shielding problems.

Tech-Etch
Braun Division

Tech-Etch, Inc. / 45 Aldrin Road, Plymouth, MA 02360 / (617) 747-0300

Two things are certain:

1. One of you will win a new Fiero.
2. The excitement begins with TMOS.



MOTOROLA



Win a Fiero with TMOS™

The chance of a lifetime in the
powerFET design contest of the year.

Imagine a brilliant new 1985 Fiero SE by Pontiac in your garage.

Or carport. Or driveway.

Whatever you park it in, or on, it'll be yours if you win first prize in our TMOS power MOSFET design contest.

The stylish, sporty Fiero is the first mid-engine car in the world to use a space-frame chassis—a bold benchmark in automotive engineering. Its unique design concepts, gleaned from race-car designs, have caught on with everyone interested in advanced, mass-produced American cars.

If you've seen one and admired its innovative styling, performance and handling, you've already started your TMOS design.

The excitement begins with TMOS.

TMOS powerFETs are today's version of the ideal switch.

Voltage-driven, low-loss, majority carrier devices, they are comprehensive, state-of-the-art solutions to high-frequency power applications requiring fast, efficient performance.

Independent of operating temperatures and fully biased with only 10 V to the gate, TMOS powerFETs simplify drive circuits and can be driven directly from CMOS and T²L to control high-power loads. Secondary-breakdown-free, they're virtually immune from thermal runaway and represent an almost unlimited evolutionary progression towards the perfect power switch.

Look how complete the line is.

Over 400 TMOS types comprise the broadest offering available.

Performance extends to 200 A, 1,000 V and leaves the also-rans behind. No one can touch our 0.009 Ω $r_{DS(on)}$ specs

for leading-edge TMOS III products. We even have P-channel for ultra-simple drive circuits.

And there are eleven different package styles to choose from, including small-signal TMOS.

Guaranteed lowest cost.

There's a direct TMOS replacement for more than 700 industry-available powerFETs. Spec for spec, package for package.

During October, November and December, we're guaranteeing you 10% off any other source's equivalent device quote or invoice.

Take any bona fide supplier's invoice or quote up to 30-days old to a Motorola factory representative and if it's for any of the 727 types we second-source, he'll duplicate the order and/or quote at 10% less. Guaranteed.

Win a car or a computer.

All it takes to qualify is your imagination and a circuit design using one or more TMOS power MOSFETs in an unusual, or cost-effective, or efficient way. We'll send you details.

1st Prize: Fully-equipped, 1985 Pontiac Fiero, 4- or 6-cylinder engine, automatic or manual transmission.

2nd Prize: Lisa Professional Computer plus up to \$1,000 of software and accessories.

Five 3rd Prizes: Macintosh Personal Computers plus up to \$500 of software and accessories.

Five Additional Prizes:

Macintosh Personal Computer plus up to \$250 of software and accessories.

All entrants will receive the official TMOS Design Contest entry package of free TMOS Data Book, contest rules, free sample offer, brochure, price list, and a handy new TMOS slide-chart Selector Guide.

Send coupon or facsimile to

Motorola
Semiconductor
Products, Inc.
P.O. Box 20912,
Phoenix,
AZ 85036.

Let the
excitement build.

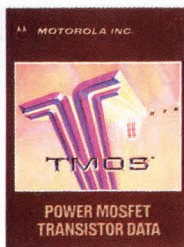
We're
on your
design-in
team.

LISA AND MACINTOSH ARE TRADEMARKS
OF APPLE COMPUTER, INC.



MOTOROLA

To: Motorola Semiconductor Products, Inc., P.O. Box 20912, Phoenix, AZ 85036
Please send me your Official TMOS Design Contest Entry Kit. 211ED103184



Name _____

Title _____

Company _____

Address _____

City _____

State _____

Zip _____

Call me () _____

"Our applications engineers always want me to buy 'the latest this' or 'the latest that.' How come USIR's never satisfied?"

Because newer, better electronic test instruments are introduced all the time, Bob, and we want to make sure we have the latest equipment for our customers.

As the leader in the electronic test equipment rental business, we have a reputation to uphold. That's why we constantly survey the industry, to make sure when new, state-of-the-art equipment is developed, we have it. We also stock our inventory in depth to make sure you can have exactly what you want when you want it.

We offer state-of-the-art financing, too, with lots of options. You can rent, lease, or buy. And you can choose from a variety of financing plans, all with very flexible terms.

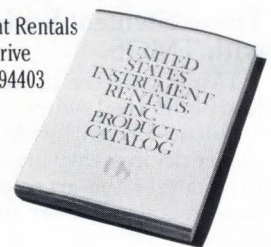
Don't settle for anything less than the latest. Call us.



To receive our new, 1984 catalog, circle the number below. This 264-page catalog is a valuable reference book, with thousands of test equipment listings, guidelines for matching applications, and suggestions for financing. And it's yours, free.

We go the extra mile.

U.S. Instrument Rentals
2988 Campus Drive
San Mateo, CA 94403
415/572-6600



United States Instrument Rentals, Inc.

US

A U.S. Leasing Company

Call toll-free

For the number of your nearest sales office,
call toll-free 800-242-USIR, ext. 932.

INTERNATIONAL MEETINGS

Custom Electronics and Design Techniques Show, Nov. 6-8. Heathrow Penta Hotel, London, England. Prodex Ltd., 79 High St., Turnbridge Wells, Kent, England TN1 1XZ; (0892) 39664.

DAK/DAP '84, Nov. 6-9. Info-Rama Centre, Sandvika, Norway. Tor Rustad, Messebyrået AS, Sandviksvn. 184, Info-Rama. Postboks 530, N-1301 Sandvika; 02-39 27 04.

Ergodesign '84, Nov. 6-9. Montreaux, Switzerland. Ergodesign '84, PO Box 122, CH-1820 Montreaux, Switzerland. (021) 63 48 48.

5th Generation Computer Systems, Nov. 6-9. Tokyo, Japan. FGCS '84, Institute for New Generation Computer Technology, Mita Kokusai Bldg., 21F, 1-4-28 Mita, Minato-ku, Tokyo 108 Japan; 03-456-3195.

Computer Peripheral and Small Computer Systems (Compec), Nov. 13-16. Olympia, London, England. Reed Exhibitions, Surrey House, 1 Throwley Way, Sutton, Surrey, England; (01) 643-8040.

Electronica '84, Nov. 13-17. Munich Trade Fair Center, West Germany. Kallman Associates, 5 Maple Court, Ridgewood, N.J. 07450; (201) 652-7070; or Münchener Messe- und Ausstellungs-gesellschaft mbH, Messegelände, Postfach 12 10 10, D-8000 München 12; (089) 51070.

1st International Photovoltaic Science and Engineering Conference and Exhibition, Nov. 13-16 and 15-18. International Conference Center Kobe, Port Island, Kobe, Japan. Secretariat of International PVSEC, % Japan Convention Services Inc., Nippon Press Center Building, Uchisowai-cho 2-2-1, Chyodo-ku, Tokyo 100, Japan.

International Symposium on Antennas (Jina '84), Nov. 13-15. Nice, France. Anne Cerboni, CNET/PAB, Centre de La Turbie, 06320 Cap d'Ail, France; =33 (93) 41 15 30.

China International Microelectronics/Computer Exhibition and Conference, Nov. 21-26. Shanghai, People's Republic of China. Harry C. Lepinske, China International Microelectronics/Computer Exhibition and Conference, American Exhibition Services International Inc., PO Box 66373, O'Hare International Airport, Chicago, Ill. 60666; (312) 593-2462.

International Spectrum Pacific, Nov. 21-23. Centrepont Exhibition and Conference Center, Sydney, Australia, Vic Sergie, IDBMA, PO Box 77, Gympie, NSW 2227, Australia; (02) 570-5505.

The Northern Computer Fair, Nov. 22-24. Belle Vue, Manchester, England. Reed Exhibitions, Surrey House, 1 Throwley Way, Sutton, Surrey, England; (01) 643-8040.

Systemotronica '84, Nov. 22-30. Moscow, USSR. Harry C. Lepinske, Systemotronica '84, American Exhibition Services International Airport, Chicago, Ill. 60666; (312) 593-2462.

Computer China, Nov. 25-Dec. 1. Xiamen Special Economic Zone, People's Republic of China. Kallman Associates, 5 Maple Court, Ridgewood, N.J. 07450; (201) 652-7070.

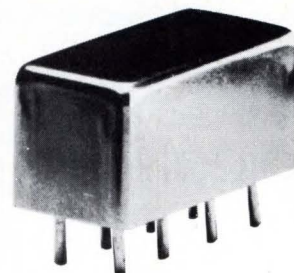
International Spectrum Europe, Nov. 26-27. Penta Heathrow Hotel, London, England. Chris Holman, IDBMA, PO Box 32, Northwood, Middx. HA6 1HZ, England.

Transducer Tempcon '84, Nov. 27-29. Harrogate Exhibition Centre, Yorks., England. Trident International Exhibitions Ltd., 21 Plymouth Road, Tavistock, Devon PL19 8AU; 0822 4671.

Electronic Displays '84, Nov. 28-30. Kensington Exhibition Centre, London, England. Networks Events Ltd., Printer Mews, Market Hill, Buckingham MK18 1JX, England; (0280) 815226.

Conference on Computer-Aided Engineering, Dec. 10-12. University of Warwick, Coventry, England. IEEE Conference Services Department, Savoy Place, London WC2R 0BL; (01) 240 1871.

electronic attenuator/switches



**1 to 200 MHz
only \$28⁹⁵ (5-24)**

**AVAILABLE IN STOCK FOR
IMMEDIATE DELIVERY**

- miniature 0.4 x 0.8 x 0.4 in.
- hi on/off ratio, 50 dB
- low insertion loss, 1.5 dB
- hi-reliability, HTRB diodes
- low distortion, +40 dBm intercept point
- **NSN 5985-01-067-3035**

PAS-3 SPECIFICATIONS

FREQUENCY RANGE, (MHz)

INPUT	1-200		
CONTROL	DC-0.05		
INSERTION LOSS, dB		TYP.	MAX.
one octave from band edge		1.4	2.0
total range		1.6	2.5
ISOLATION, dB		TYP.	MIN.
1-10 MHz IN-OUT		65	50
IN-CON		35	25
10-100 MHz IN-OUT		45	35
IN-CON		25	15
100-200 MHz IN-OUT		35	25
IN-CON		20	10

IMPEDANCE 50 ohms

For complete specifications and performance curves refer to the 1980-1981 Microwaves Product Data Directory, the Goldbook or EEM.

finding new ways...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
2625 E. 14th St. B'klyn, N.Y. 11235 (718) 769-0200
C76-3 REV ORIG

HITACHI EXPANDS ITS

New Designs for Industrial Applications with
Typical $R_{DS(ON)}$ as Low as .03 Ohms.

NEW Series

SPL Availability *July **August ***October

Package	Type Number		Application	Electrical Characteristics ($T_C = 25^\circ\text{C}$)			
	N-ch	P-ch		V_{DS} (V)	I_D (A)	P_D (W)	Typ. $R_{DS(ON)}$ (Ω)
DDAK	2SK548*		Ultrasound Diagnostic Equipment	500	1.5	10	4.0
TO-220 AB	2SK549*		DC/DC Converter	60	10	50	0.1
	2SK550*		DC/DC Converter, Relay	60	25	75	0.03
	2SK551*	2SJ127***	Motor Drive, DC/DC Converter	120	10	50	0.15/0.2
	2SK552*		Switching Regulator	450	5	50	1.2
	2SK553*			500	5	50	1.5
	2SK554*			450	8	75	0.65
TO-3P	2SK555*			500	8	75	0.8
	2SK556**		Switching Regulator	450	12	100	0.45
	2SK557**			500	12	100	0.6
	2SK558*		Motor Drive	500	12	100	0.55
	2SK559**		Switching Regulator	450	15	100	0.25
TO-3	2SK560**			500	15	100	0.30
	2SK561*		DC/DC Converter, Relay	100	30	125	0.04

Standard Lineup

Package	Type Number		Application	Electrical Characteristics ($T_C = 25^\circ\text{C}$)			
	N-ch	P-ch		V_{DS} (V)	I_D (A)	P_D (W)	Typ. $R_{DS(ON)}$ (Ω)
DDAK	2SK416	2SJ120	Coil Driver, Switch	40	2	10	0.5/1.2
	2SK429		DC/DC Converter	100	3	20	0.5
	2SK430			150	3	20	0.8
	2SK375		Ultrasound Diagnostic Equipment	300	1	10	2.5
	2SK535		Switching Regulator	400	1.5	20	4.0
	2SK384		Analog Switch	500	0.3	10	25
	2SK511		Display	250	0.3	0.75	30
	2SK346	2SJ102	Motor Drive	60	5	30	0.3
TO-220 AB	2SK428	2SJ122	DC/DC Converter	60	10	50	0.1/0.15
	2SK383			100	10	50	0.15
	2SK440		Switching Regulator	200	6	40	0.4
	2SK310	2SJ117	Switching Regulator	400	3/2	40	2.5/5.0
	2SK311		Ultrasound Diagnostic Equipment	450	3	40	2.5
	2SK319		Switching Regulator	400	5	50	1.1
	2SK320			450	5	50	1.1
	2SK382			500	2	30	2.5
	2SK513			800	3	60	5.0
	2SK399	2SJ113	Motor Drive	100	10	100	0.2/0.25
TO-3P	2SK414	2SJ119	Switching Regulator	160	8	100	0.4
	2SK400	2SJ114		200	8	100	0.5/0.6
	2SK412			250	10	100	0.3
	2SK349		Switching Regulator	400	10	100	0.67
	2SK350		Chopper	450	10	100	0.67
	2SK415		Arc Welder	800	3	100	5.0
	2SK534			800	5	100	3.0
	2SK398	2SJ112	Switching Regulator	100	10	100	0.2/0.25
	2SK308		Motor Drive	120	10	100	0.2
	2SK401			250	10	100	0.3
TO-3	2SK298	2SJ116	Switching Regulator	400	8	100/125	1.1/1.75
	2SK299		Chopper	450	8	100	1.1
	2SK312		Arc Welder	400	12	125	0.67
	2SK313			450	12	125	0.67
	2SK512			500	12	125	0.55
	2SK351			800	5	125	1.7

Specifications subject to change without notice.

Look at these exciting new additions to Hitachi's broad line of more than 100 popular Power MOS FETs.

These devices are ideally suited for use in a wide variety of industrial product applications, which include DC to DC converters, switching regulators, PWM motor drives...any application requiring high switching speeds, low $R_{DS(ON)}$ and high resistance to electrically induced failure.

Breakdown voltages range from 20V to 800V, with drain current capabilities to 30 amps.

Hitachi Power MOS FETs are priced right, with fast delivery of production quantities, backed by world-wide technical support.

Call now to upgrade your designs with Hitachi's newest industrial Power MOS FETs.



POWER MOS FET LINE

FAST ACTION

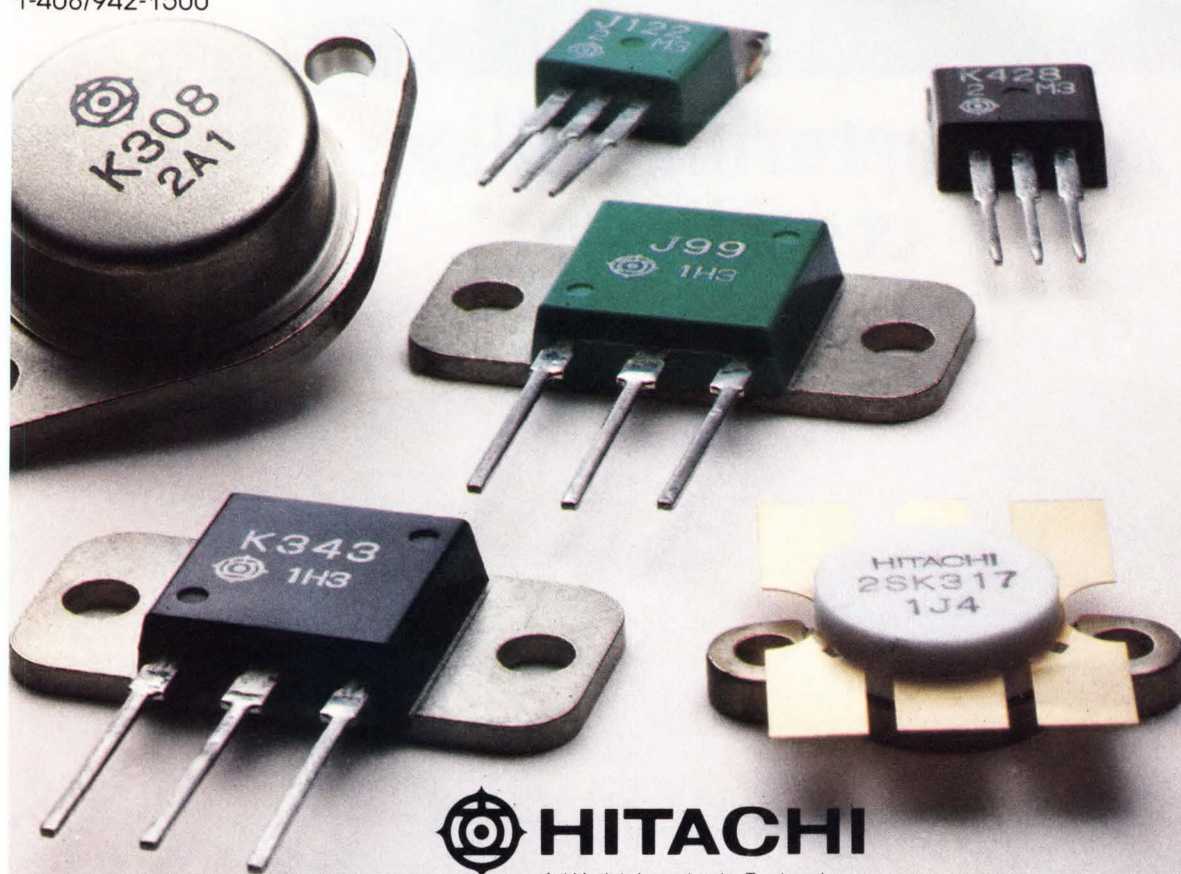
To obtain product literature immediately,

CALL TOLL FREE

1-800-842-9000, Ext. 6809. Ask for literature number 709.

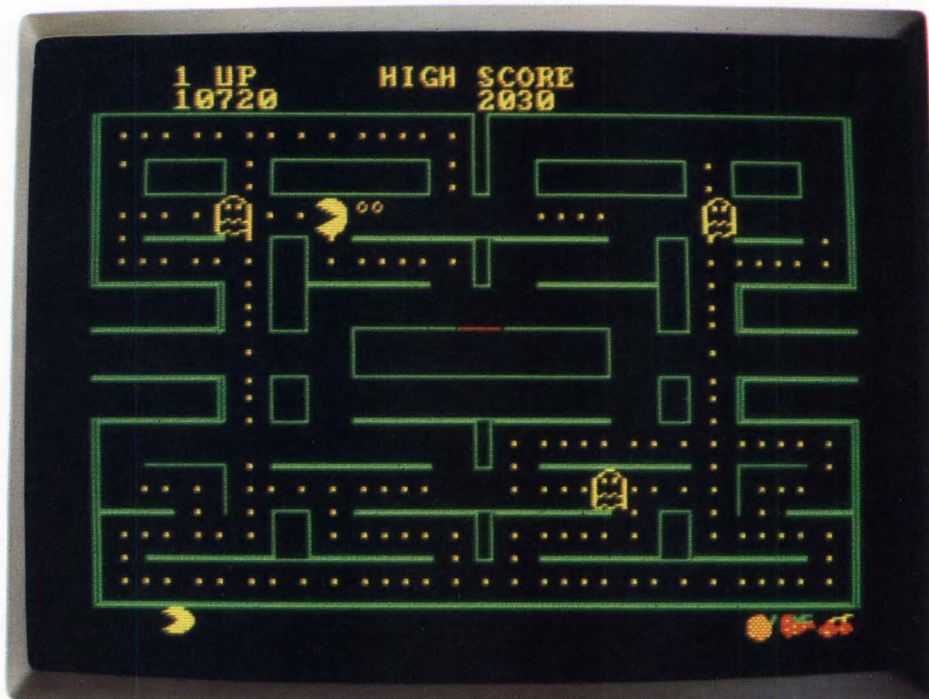
Hitachi America, Ltd.

Semiconductor and IC Sales
and Service Division
2210 O'Toole Avenue
San Jose, CA 95131
1-408/942-1500

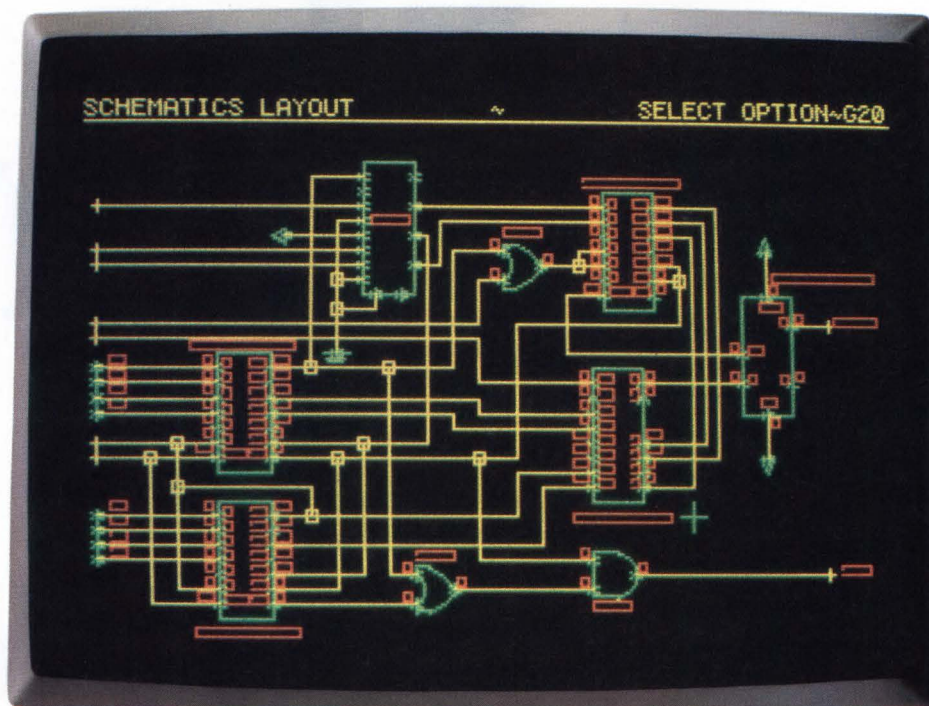


HITACHI

A World Leader in Technology



After capturing millions
of goblins,



the IBM PC has learned to capture circuit logic.

You're looking at the first of a new line of software products designed to turn the IBM PC, PC XT or PC AT into a very powerful engineering workstation.

It's called REDLOG™ and has the kind of capabilities normally found only in an expensive CAE workstation.

REDLOG can cut in half the time it takes to design even complex circuits. It has the features and responsiveness normally found only in a supermini.

How did we get so much power into software that runs on a personal computer? Well, when you've been writing software for electronic CAD for almost twenty years, and logic capture software for ten years, you get to learn some very interesting techniques. Especially when you have all the resources that a \$1.3 billion company can give you.

If you're still not convinced anyone can get the PC to work like a workstation, we have a suggestion. Ask for a demonstration.

Clip your business card to this ad and send it to Racal-Redac, Lyberty Way, Westford, MA 01886. Or call (617) 272-1628.

RACAL-REDAC
Linking Concept to Product

REDLOG is a trademark of Racal-Redac. IBM PC, PC XT and PC AT are trademarks of International Business Machines Corp. Ms. Pac-Man is a registered trademark of Atari, Inc.

**So
how many
years
would you
like to take
off?**

Before you waste any more time, you may want to read about this.

VRTX®. That being the real-time operating system packaged in silicon. From Hunter & Ready.

It's a versatile kernel, efficient I/O system and flexible file manager.

Or to put it another way, it's everything you'd want in a multi-tasking operating system.

But not in the usual all-or-nothing sense of the word.

Fact is, you can use as much — or as little — as you like. And yes, then take as many years off as you like.

A good place to start is the VRTX kernel. Because with it, you can subtract two years from a lengthy design cycle.

Think of it as task management, real-time clock support, dynamic memory allocation, basic I/O, interrupt handling and fast pinpoint timing — all rolled into a neat 4K of memory.

OK, sounds like a lot, but not quite two years? You're right. That doesn't just come from design time. But from what makes VRTX as reliable as a quartz watch.

100,000 manhours of debugging and testing. The stuff nights and weekends can be made of.

Still you'll be happy to know, for all VRTX takes off, there's not much to give up.

Unlike other operating systems, it doesn't lock you into one processor

for life. Or tie you to one type of I/O and file management forever. VRTX is compatible with all major processor families and all standard types of file management and I/O.

And with that choice, we're back to the count.

Meaning if you don't want to spend time on I/O, take off another two years. Since our IOX component works with VRTX to take care of all block, disk and character I/O.

And right along with that goes our FMX file manager. And another two years off. Besides which, FMX includes all the things you'd want in a hierarchical file system. Concurrent file access. Random and sequential access. And compatibility with standard file systems, including none other than PC-DOS.

We could go on. But it's now time for our final summation.

A total of six years if you want it all off (VRTX, IOX and FMX). Two or four years if you'd like a real-time head start.

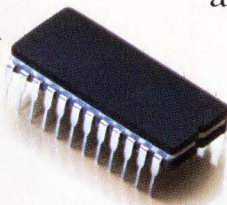
Or if you'd like to know more before you decide,

write Hunter & Ready, 445 Sherman Avenue, Palo Alto, CA 94306. Or call (415) 326-2950.

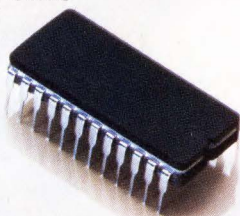
There should always be more than one way to buy time.

HUNTER ♦ READY

We've taken the hard part out of operating systems.



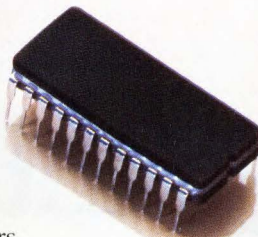
2 Years

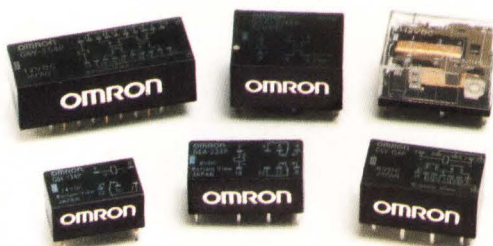


4 Years



6 Years





Moving loop PC board relays use approximately one-third the board space while reducing power consumption by as much as two-thirds.

Quality. Quantity.

Through advanced manufacturing technology, we're keeping an eye on quality without letting production costs get out of sight.

Look to Omron for the state-of-the-art in component manufacturing.

Our totally automated assembly lines are helping us produce more than 700,000,000 relays and

switches per year. Advanced computer monitoring systems are scanning continuously for the slightest variations between products at every stage of production. Through our advanced Q.A. systems, we're holding tolerances so tight that, in many cases, we've completely eliminated a customer's need for incoming inspections.

Our expertise in high-volume production of "standardized" components helps us hold the line on

costs. And those manufacturing efficiencies are reflected in the quality and cost-savings we pass on to our customers.

How an electronic component is made tells you a lot about performance, reliability and cost. That's why we'd like to show you a short video presentation of our manufacturing capabilities. Please call **1-800-621-6413**.

In Illinois: 312-262-7783.

OMRON

We're in control

CIRCLE 60 FOR MORE INFORMATION

CIRCLE 71 FOR VIDEO PRESENTATION

snap-action, thumbwheel, illuminated, key, DIP switches • printed circuit board, general purpose, power, solid-state relays • photomicrosensors

"SEE US AT WESCON BOOTH #1683"

Win Exciting Prizes!

enter Mini-Circuits'

Design Contest



IBM® PC Personal Computer,
dual disk-drives, printer, software
(word processing, spreadsheet and planner).
A complete system ... a **\$4,000 VALUE!***

2-4-6 hr. VHS Videocassette Recorder
3 speed, remote control, timer,
electronic tuning ... including 6 tapes
... a **\$500 VALUE!***

IBM is a registered trademark of International Business Machines Corporation.
*Value at time of press. All applicable taxes and duties are the sole responsibility of the winner.

F 93-A REV. ORIG.

Design Contest



It's Easy to Enter

Do you have a clever design idea or application involving IF/RF/microwave signal-processing components—mixers, power splitter/combiners, attenuators, RF transformers, directional couplers, amplifiers or RF switches? Or perhaps a versatile setup for testing them or a novel approach to enhance their performance.

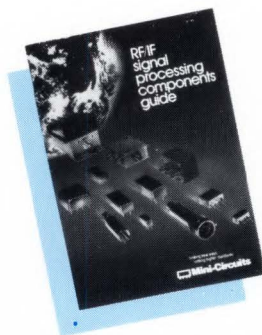
If you have an original idea, enter Mini-Circuits Design Contest now. Type or legibly print your submissions. Start with a brief abstract describing the key point of your idea (cost saving, improved performance, simplified testing, etc.). List RF signal processing components used. Then proceed with the detailed explanation. Make schematics and block diagrams clear; include values of circuit components. Be sure to include performance data and curves; judges' scores will be based on content, multiplicity of products involved and thoroughness.

Contest Rules

1. Submit as many entries as you wish.
2. Ideas should be original and non-proprietary.†
3. Entries will be judged by the editorial staff of Microwave Journal and their decisions will be final. The top 25 winning entries will be published in Microwave Journal.
4. All entries become the property of Mini-Circuits Laboratory and must be received by December 31, 1984.
†Winners may be asked to sign an affidavit of eligibility & release.
5. Employees of Mini-Circuits Laboratory, Microwave Journal and their sales representatives, are not eligible.
6. Contest void where prohibited by law.
7. Make sure to include your business address and phone number. In addition, for non-U.S. entries, indicate AC power line voltage and frequency.
8. Send your entries to:
Mini-Circuits' Design Contest
P.O. Box 137
Brooklyn, NY 11235

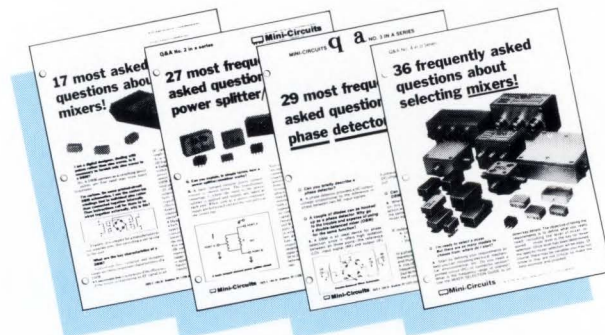
Good Luck, and Thanks.

The Mini-Circuits Design Contest, with its competitive excitement and fabulous prizes, is our way of thanking all of the designers worldwide whose staunch customer support has been responsible for our continuing growth.



Free 64-page RF/IF Signal Processing Components Guide

For an up-to-date review of Mini-Circuits' IF/RF/Microwave product line, refer to EEM, EBG, Gold Book or Microwaves Directory. Or call/write our factory or any of our 45 worldwide sales offices for our 64-page RF Signal-Processing Components Guide.



Free fact-filled Question/Answer Series on RF Signal-Processing Components

Since Mini-Circuits is the world's largest manufacturer of mixers and RF signal-processing components, it's natural for us to receive hundreds of questions from engineers on these products. How to test them, how to make the right selection, how to optimize a circuit design... questions with answers not found in textbooks or reference manuals.

So we've put together a series of Q & A (question/answer) booklets on most-frequently asked questions on mixers, phase detectors and power splitter/combiners. They are loaded with application-oriented tips, ready to solve a problem you may be facing. The set is free... just call or write us or any of our 45 worldwide sales representatives.

send your entries to:

EXAMPLE 1:

Mini-Circuits' Design Contest
P.O. Box 137,
Brooklyn, New York 11235

Low-cost, high performance Image-Rejection Mixer.

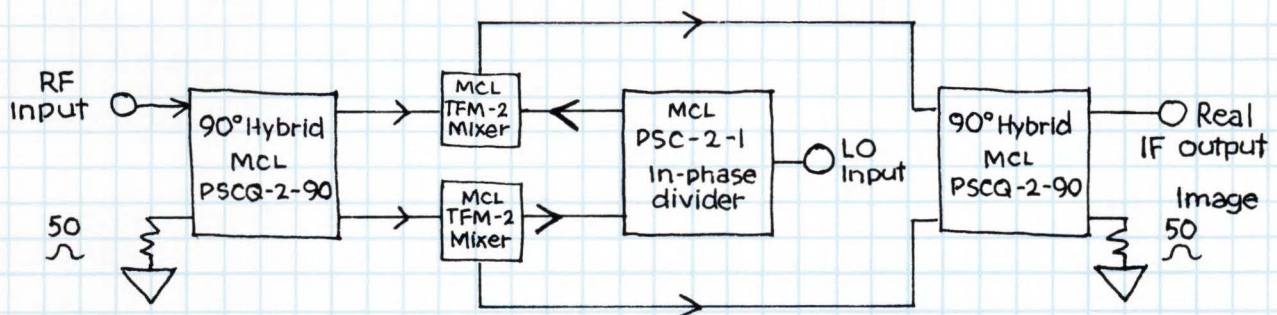
KEY COMPONENTS; mixers, power splitters.

Many telecommunications systems require a mixer arrangement that delivers the desired IF and sharply rejects the other image frequency.

An effective, low-cost solution makes use of Mini-Circuits' TFM-2 mixers and it's 2-way, 0° PSC-2 and 2-way, 90° PSCQ-2-90 power splitter/ combiners as shown in the diagram.

The key to an efficient image-rejection, such as shown in the block diagram, is the use of double-balanced mixers with well-matched amplitude and phase characteristics and high isolation. However, poor hybrid phase characteristics, differences in the output amplitudes of the hybrids and non-symmetrical external circuits will also reduce image-rejection performance. The effects on sideband suppression caused by unequal mixer amplitude and phase shift are shown in Tables 1 and 2.

Table 1 Amplitude Unbalance vs. A, dB		Table 2 Phase Unbalance A, dB	
Unbal, dB	A, dB	Phase Unbal, degree	A, dB
0.3	35	3	33
0.9	27	9	22
1.5	22	15	18
2	13	20	15
3	15	30	12



JOSEPH CANTORE,
Engineering Dept.,
Alphaomega Corp.,
11 Madison Street
Key Biscayne, Florida 33149

finding new ways ...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
P.O. Box 166, Brooklyn, New York 11235 (718) 934-4500
Domestic and International Telex 125460 International Telex 620156

EXAMPLE 2:

Mini-Circuits' Design Contest
P.O. Box 137,
Brooklyn, New York 11235

Improving two-tone, third-order IM measurements.

KEY COMPONENTS; power splitters, attenuators, amplifiers

Two-tone, third-order intermodulation (IM) expresses the degree of non-linearity of an amplifier or mixer. This parameter is generally not included on data sheets because it is dependent upon operating frequencies, terminating impedance and input levels; it must be measured under specific design performance conditions.

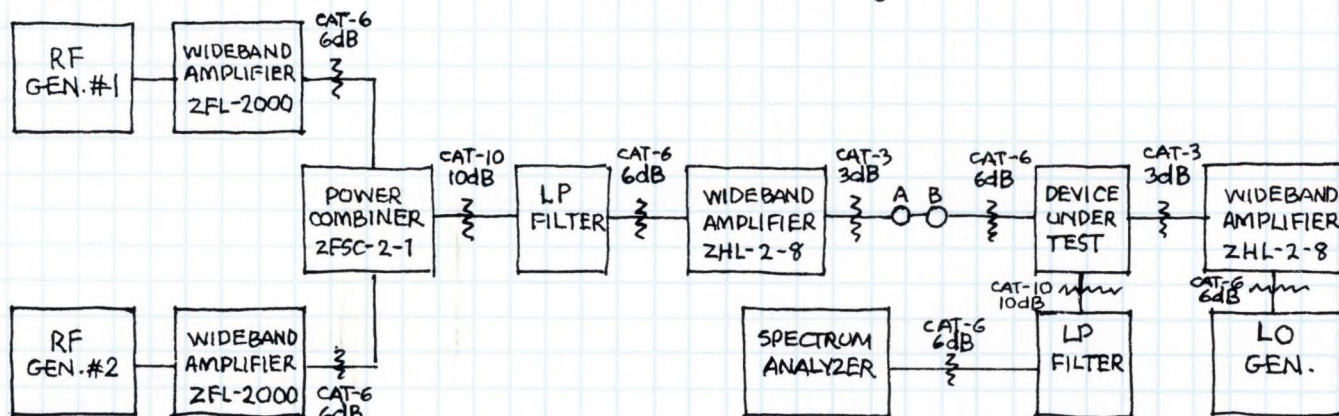
Two common errors in these measurements are (1) failure to provide adequate isolation between input signal generators and proper impedance matching and (2) insufficient filtering of the two input test signals.

A proper test setup for measuring two-tone, third order IM distortion is shown. Note the use of two amplifiers and 6dB pads for input generator isolation and proper 50 ohm matching. A practice of simply using a Tee-connector between generators develops mismatches, producing undesired harmonics which dramatically affect accuracy.

Two-tone, third-order IM distortion is only meaningful when the input levels to the device-under-test are defined.

Examining the spectrum analyzer display for a ZAY-1 double-balanced mixer. Notice the significant difference in two-tone, third-order component with an input level of -10dBm for each tone (b) compared with 0dBm input level for each tone (a).

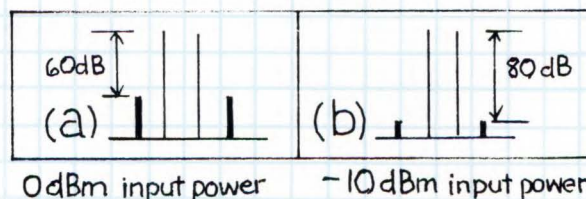
Also, the amount of two-tone, third-order must be specified relative to either the RF input or desired IF output; the desired IF output is more meaningful.



GENERAL NOTES

- 1) All Mini-Circuits products have model numbers shown.
- 2) 0dBm input, A-B connected as shown
-10dBm input, insert CAT-10, 10dB between A-B

JOSEPH CANTORE,
Engineering Dept.,
Alphaomega Corp.,
11 Madison Street
Key Biscayne, Florida 33149



finding new ways ...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
P.O. Box 166, Brooklyn, New York 11235 (718) 934-4500
Domestic and International Telex 125460 International Telex 620156

Custom designed for Process Industries

\$199

Basic dual bar graph

*features:

Bar or cursor
display

Single or dual
bar graph

Single bar graph
available with—
expanded scale
peak and valley
control points
high speed display

Ranges available upon request;
from 50 mV to 200 V
and 500 μ A to 100 mA.

MODEL 555

Microprocessor based programmable bar graph

*CONCEPT

Triplett is introducing a new programmable bar graph meter. It is a microprocessor based unit that was designed with the process control industry in mind. The ultrasonic welded window provides a dust and contamination resistant unit when installed. The meter incorporates an easily accessible DIP switch configuration for programming any one of 32 possible outputs on a brilliant 50 bar LED display. The different programming modes make possible the changing of the Model 555 for other applications thus eliminating the need to purchase additional meters and scrapping present ones.

Simple external wiring on an edge connector enables the user to have additional features such as peak and valley readings, expanded resolution, flashing or solid control points and even a cursor display if desired.

*SPECIFICATIONS

Display: Two 50 segment, light emitting diodes, bar graph displays and 4 annunciators.

Accuracy: Dual Bar Graph	$\pm 2\%$ of Full Scale
Zero Center Scale	$\pm 4\%$
Single Bar Graph	$\pm 2\%$ of Full Scale
Zero Center Scale	$\pm 4\%$
Expanded	
Single Bar Graph	$\pm .2\%$ of Full Scale
Zero Center Scale	$\pm .4\%$
Set Point	$\pm .2\%$ of Full Scale

Input Impedance: 1 Million Ohms @ 50 mV. Standard milliamp units have a 50 mV compliance voltage drop across the input. Suppressed units have a 62.5 mV compliance voltage drop across the input.

Annunciator Interface: Open Collector Output.

$V_{CEO} = 30V$

$V_{CE} = .4V @ I_c = 16mA$

$I_c (max) = 300mA$

Power Supply: 5 V $\pm 5\%$, 30 mV Ripple, 300 mA.

Size: 1/4 DIN front panel (192 mm x 48 mm), (7.560" x 1.890").



**When you want QUALITY—
Ask for TRIPLETT**

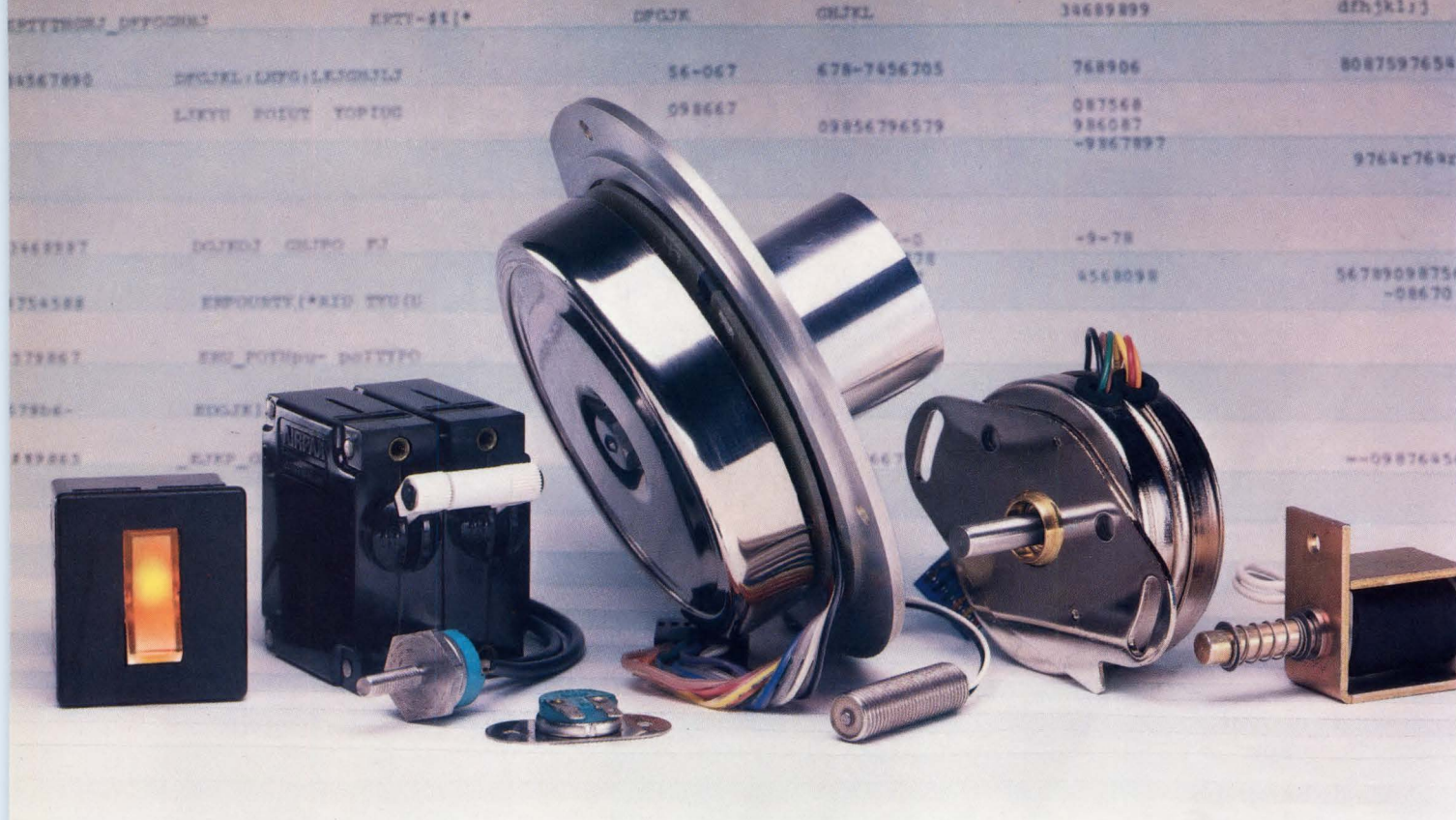
CIRCLE 61

CIRCLE 62 FOR FREE DEMONSTRATION

For more information on nearest authorized Mod Center contact Don Klaus or Jack Martz at Triplett Corporation, One Triplett Drive, Bluffton, OH 45817, (419) 358-5015, TWX (810) 490-2400.

TRIPLETT
A **Penril** COMPANY

See us at WESCON/84 Booth 1330



**We have the
components that
make your disc
drive drive, your
printer print,
etc., etc.**

We have the electromechanical components you need for your computers and peripherals. And the responsiveness you need to keep your production rolling.

For memory units, we supply solenoids and a complete line of brushless DC motors designed for 5¼" to 18" disc drives. And linear actuators that position read/write heads in precise digital steps.

For printers, we make rotary steppers and subfractional HP motors, and magnetic pick-ups.

For microcomputers, minis and mainframes, Airpax magnetic circuit breakers assure positive protection. They're unaffected by ambient temperature, and serve the dual function of power switch and overload protection.

And Airpax thermostats monitor cabinet temperatures, and shut down systems instantly when overheat threatens sensitive circuits.

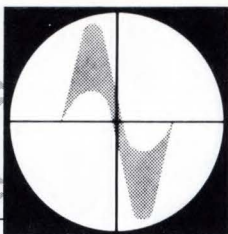
You can select from our thousands of standard models. Or we'll create a custom model for you, and produce a few dozen for prototypes, or millions for a production run.

Ask us for engineering data. Airpax Corporation, a North American Philips Company, W. Johnson Ave., Box A, Cheshire, CT 06410. (203) 272-0301.

AIRPAX®
We give you control.

"See Us At Wescon Booth No. 3454-3462"

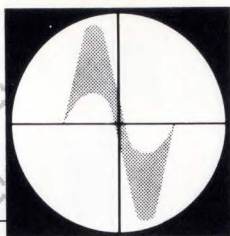
electronica 84 electronica
a 84 electronica 84 elec
electronica 84 electronica
a 84 electronica 84 elec



nica 84 electronica 84 el
electronica 84 electroni
nica 84 electronica 84 el
electronica 84 electroni

T

he biennial International Trade Fair and Congress for Components and Assemblies in Electronics, better known as Electronica, again shapes up as one of the largest and most international of electronics shows. Running Nov. 13-17 at Munich's Trade Fair Center, Electronica 84 will host 2183 exhibiting companies, half of them West German (including subsidiaries of foreign companies) and the other half from around the world, including concerns from the Far East and Eastern Europe. Featured at the show will be semiconductors, passive components, and test and measurement equipment. Here's a sampling of the many new products to be displayed.



74HCT CMOS octal chips sink 160 mA, withstand a latch-up current of 80 mA

A series of 74HCT high-speed CMOS octal ICs sinks a maximum of 160 mA—almost five times the value of the proposed JEDEC 40.2 specifications. In addition, the devices, developed jointly by Plessey, Mitel, and Marconi Electronic Devices, are guaranteed to with-

stand a latch-up current of 80 mA, four times that proposed by JEDEC.

The range consists of 21 devices: decoder-demultiplexers, line driver-buffers, transparent latches and flip-flops, and a bus transceiver. The only nonoctal member of the family, the 20-pin 74HCT515, is the first commercially available single-chip pro-

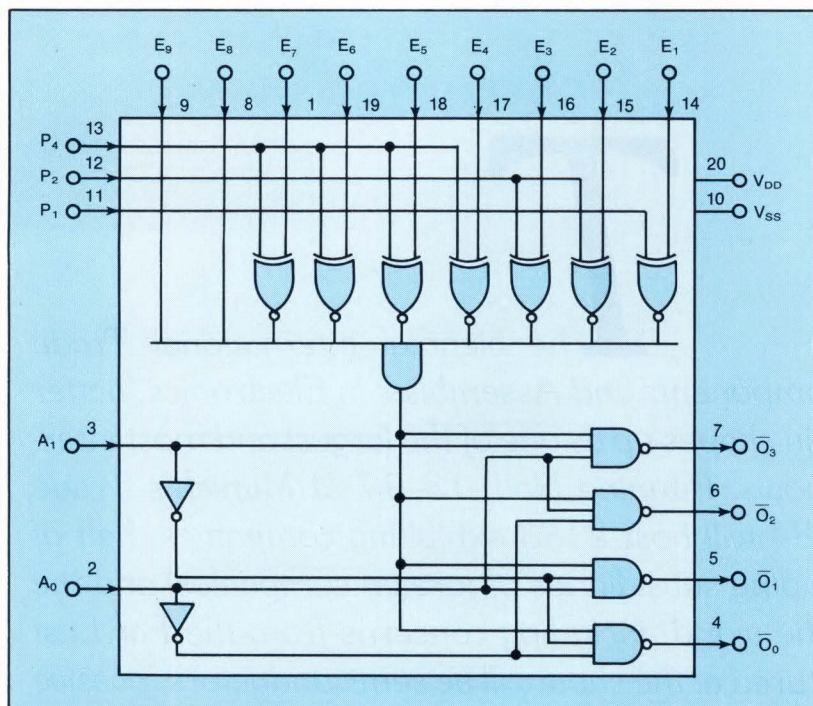
grammable decoder-demultiplexer. It is particularly suited to computer or micro-computer systems in which the location of various peripheral interface and memory devices can be mapped by a programmed 9-bit field.

The chip, which requires a supply voltage of 7 V maximum and dissipates 450 mW, is a two-in, four-out device with active-low outputs that are enabled by a pin-programmable AND gate (see the figure). This gate has seven inputs that are programmable to be active low or high and two that are permanently active-high.

All the octals have TTL input and output levels and are pin- and speed-compatible with their types in 74LS low-power Schottky counterparts. They meet or exceed all proposed JEDEC standards; the maximum clock frequency, for example, is 30 MHz (JEDEC specifies 20 MHz), and the guaranteed output current sink is 12 mA for TTL logic levels (twice the value demanded). They will be made by Mitel and Marconi.

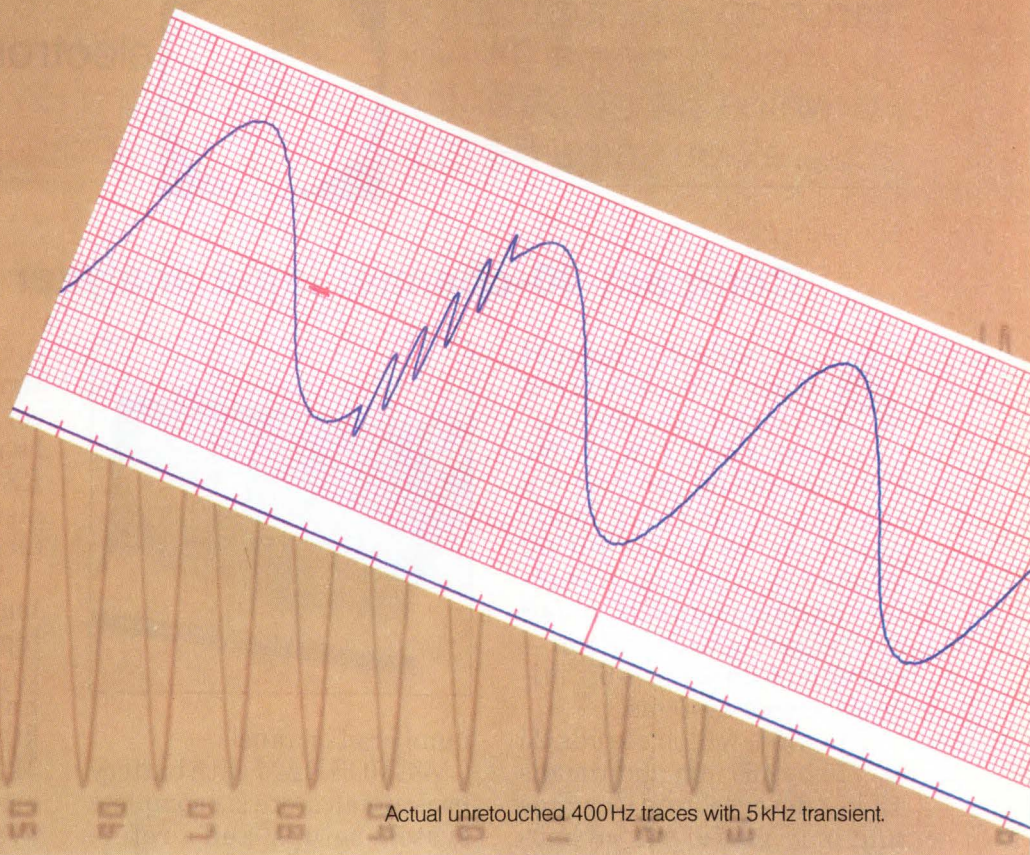
Plessey Semiconductors Ltd., Cheney Manor, Swindon SN2 2QW, England; (0793) 36251; Telex: 449637.CIRCLE 520

Mitch Beedie



Programmable inputs P_1 , P_2 , and P_4 are used to make inputs E_1 – E_7 on the 74HCT515 decoder-demultiplexer active low or high; inputs E_8 and E_9 are permanently active high. The chip thus offers a programmed 9-bit field for memory mapping.

Gould...Innovation and Quality in Oscillographic Recording



Actual unretouched 400 Hz traces with 5 kHz transient.

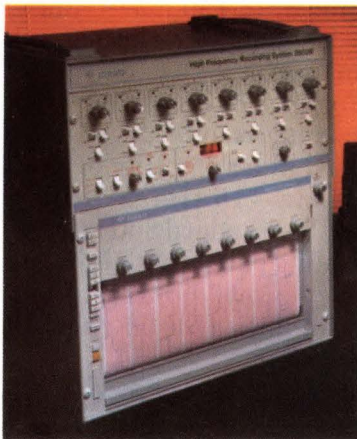
Here's why over 75% of the people in the market for a light beam recorder shouldn't be.

Because there's a better alternative from Gould. The 2000W high frequency oscillographic recorder. Compare the two and you'll see there's no comparison.

As the chart shows, you get a much higher frequency response and chart speed plus a better transient response with the 2000W system.

You also get features a light beam recorder doesn't offer at all. Like triggering and pre-triggering capability and digital data output.

Plus, the 2000W system gives you low cost, hard copy in pressurized ink or thermal writing. Our paper won't fade so you'll always have a crisp, clear record. And it's just 9¢ a



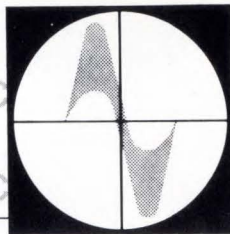
foot compared to 51¢ for a light beam recorder. A big enough savings to pay for itself.

So instead of a light beam recorder, go with the 2000W system. It's the sensible choice.

For complete literature, write Gould Inc., Recording Systems Division, 3631 Perkins Avenue, Cleveland, Ohio 44114. **Or call toll-free 800-447-4700, operator 100.**

	Response		Trace	Chart
	Frequency	Transient	Quality	Speed
Gould 2000W	50kHz	10 μ s	Excellent	13000ips
Leading Light Beam	5kHz	50 μ s	Fair	160ips

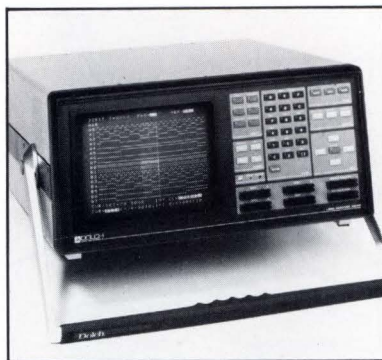
Nobody else comes close.



Compact 40-channel logic analyzer is low-cost

A portable 40-channel logic analyzer from Dolch Logic Instruments costs only DM 13,950. For that price, the PALAS (Personal Advanced Logic Analysis System) 40C50 sports a 9-in. display and offers 32 data channels, plus 8 for trigger qualification—enough to analyze 8-bit microprocessor systems.

The unit, which stands 25 by 220 by 460 mm and weighs 15 kg, detects 5-ns glitches and may perform synchronous and asynchronous clocking simultaneously. Its memory depth is 1000 bits, and it has a 25-MHz maximum sampling rate may be doubled by halving the



number of channels.

A CMOS RAM with battery backup can store six complete system setups, and a reference memory allows input waveforms to be searched and compared, for tracing intermittent faults.

Triggering, with real-time monitoring, is possible for

four sequential events. The timing diagram and all protocol and menu parameters can be printed out over the unit's RS-232 interface. There is also an IEEE-488 bus interface for remote control.

A set of six compact active logic probes comes with the logic analyzer; arranged in four channel blocks, they have an impedance of 50 k Ω /10 pF or, optionally, 1 M Ω /10 pF. Personality adapters and disassemblers are available for most standard 8-bit microprocessors.

Dolch Logic Instruments, Justus-von-Liebig-Str. 19D, 6057 Dietzenbach, West Germany; (06074) 40020; Telex: 4191550 dli d. **CIRCLE 526**

Codec and filter chip needs no extra parts

A single-chip codec and filter eliminates the need for external components. It is designed to link a subscriber line interface circuit (SLIC) with the PCM highway through the peripheral board controller proposed by Siemens and Intel for digital exchanges.

Besides performing pulse-code modulation and filtering, Siemens's PEB260 allows termination impedance, echo suppression, and other analog parameters to be set by software.

Available in a 20-pin DIP, it needs neither an RC filter to

match the complex line impedance from the SLIC nor an external crystal. It consumes only 150 mW from a ± 5 -V supply when active and 50 mW on standby.

For transmission, the analog signal from the SLIC is digitized at a sampling rate of 128 kHz—16 times higher than the standard 8-kHz PCM sampling rate. This high frequency gives high resolution and simplifies the on-chip filter circuits.

Digital signal processing is employed for the main filter functions; the digital signal is filtered by a 4-MHz pipe-

lined processor using 20-bit fixed-point arithmetic. Once filtered, the signal is compressed and sent to the peripheral board controller.

During reception, the incoming PCM signal is expanded, and interpolated values are inserted between successive measured values. The resultant signal, which corresponds to a sampling rate of 256 kHz, is then filtered, converted back into analog form, and passed on to the SLIC.

Siemens AG, Postfach 103, D-8000 Munich 1, West Germany; (089) 2340; Telex: 898214. **CIRCLE 527**

Gould...Innovation and Quality in Waveform Recording



Here's how to get more recording capability without replacing your present recorders.

Gould's new 4300 waveform recorder, with its exclusive multichannel analog output capability, lets you expand the performance of all your strip chart, oscillograph or instrumentation tape recorders.

The 4300 waveform recorder will increase your frequency response with its dc to 50 kHz range. It will help you capture faster transients with its 10 μ s capability. And you'll get a full measurement range of 50 mV to 500V full scale.

What's more, the 4300 will give you the convenience of triggering for unattended operation and recording by exception. With 4, 6 or 8 channels and up to 32 k per channel memory, you can be sure to capture all the

data you need, when you need it.

Plus, its IEEE 488 and RS 232C interfaces provide digital data output to any personal or mainframe computer.

So, expand the capability of your present recorder with the Gould 4300 and protect your recorder from premature obsolescence. Plus, you can begin to realize the long term savings in paper and equipment costs today.

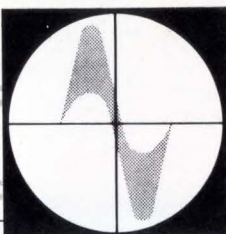
For complete literature, write Gould Inc., Recording Systems Division, 3631 Perkins Avenue, Cleveland, Ohio 44114. **Or call toll-free 800-447-4700, operator 100.**

Nobody else comes close.



GOULD
Electronics

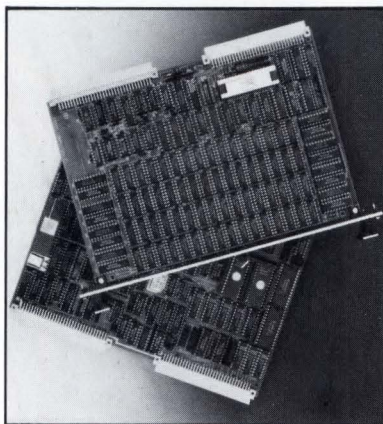
CIRCLE 65



VME cards manage 1024 by 1024 pixels

A master and a slave board, the minimum configuration of a high-resolution VMEbus graphics subsystem from Force Computers, together display almost any format within 1024 by 1024 pixels on a raster-scan CRT. The display window is up to 1024 by 800 pixels per screen, and each pixel is 4 bits deep. With two or three slave boards, the pixel depth becomes 8 or 12 bits, allowing 4096 colors to be displayed simultaneously.

The SYS68K/GDC-1M master board uses a 68000 processor that executes the on-board graphics firmware and contains a color map stored in static RAM consist-



ing of three 2k-by-8-bit color look-up tables and three 8-bit d-a converters for video output to a standard monochrome or RGB color monitor. It communicates with the GSYS68K/GDC-1S slaves over a local extension bus.

Communication with the VMEbus goes through a 16-kbyte dual-ported RAM.

Each slave board contains one 7220 graphics controller and 512 kbytes of video RAM.

The system generates circles, ellipses, and filled rectangles, and allows zooming, windowing, soft scrolling, and split screens. The boards will be shown on the stand of Synetec Datensysteme.

Force Computers Inc., 2041 Mission College Blvd., Santa Clara, Calif. 95054; (408) 988-8686; Telex: 172465.

Force Computers GmbH, Daimlerstr. 9, 8012 Ottobrunn b. Munich, West Germany; (089) 609-2033; Telex: 524 190 forc-d.

CIRCLE 523

IEEE-488 controller is also IBM PC look-alike

As well as controlling automatic measuring and test systems over the IEEE-488 bus, the PCA 5 controller from Rohde & Schwarz serves as a personal computer running MS-DOS 2.0 and is compatible with the IBM PC.

Based on an 8-MHz iAPX 186 CPU, the controller has 256 kbytes to 1 Mbyte of RAM and one or two 5¼-in. 720-kbyte floppy-disk drives, one of which may be replaced by a 5¼-in., 13-Mbyte Winchester disk drive. Up to 22

expansion boards may be slotted into the unit's Multi-bus backplane in the unit.

The controller incorporates two bit-mapped graphics processors capable of zooming, drawing circles, and labeling. Graphics (400 by 600 pixels) and text (30 lines of 80 characters) can be displayed simultaneously on the unit's 9-in. screen. Other displays may be connected to the controller's video output. There are two IEEE-488 interfaces (with the possibility for DMA), six RS-232 interfaces, and three

TTL-level I/O ports with 65 lines each (one I/O port takes up two expansion slots).

The keyboard has 10 user-programmable function keys, plus 8 soft keys.

The unit runs a version of Basic that is tailored for electronic measurements. The CP/M-86 operating system is optional.

Rohde & Schwarz GmbH & Co. KG, Muldorfstr. 15, Postfach 80 14 69, D-8000 Munich, West Germany; (089) 41292625; Telex: 523703.

CIRCLE 522

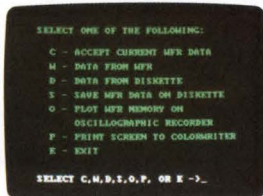
Gould...Innovation and Quality in Data Acquisition



Here's how to start analyzing data in minutes instead of weeks.

Buy the Gould DASA 9000. It's the only data acquisition system with turnkey, menu-driven software for signal acquisition; with multi-channel, high-resolution color graphics; and with data file management. You don't spend weeks or months writing your own programs. You can begin to use this versatile, easy-to-operate system immediately.

Response of the system's multichannel signal digitizer is from dc to 50 kHz per channel providing for high speed signal acquisition for up to 32 channels. Also, hardware trigger and a large internal memory with up to 100% pretrigger capability make the DASA 9000 ideal for single shot or transient recording.



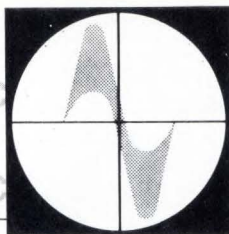
The signal digitizer also allows realtime recording using oscillographs or instrumentation tape recorders. In addition, test data can be automatically outputted to disk or graphed by Gould's multipen digital plotters.

Gould uses its more than 40 years experience in signal conditioning, acquisition and display to make it easy for users of analog instruments to digitize, store, retrieve and analyze test results.

For complete literature, write Gould Inc., Recording Systems Division, 3631 Perkins Avenue, Cleveland, Ohio 44114. Or call toll-free 800-447-4700, operator 100.

Nobody else comes close.

electronica 84 electronica 84
 a 84 electronica 84 elec
 electronica 84 electronica
 a 84 electronica 84 elec



nica 84 electronica 84 e
 electronica 84 electron
 nica 84 electronica 84 e
 electronica 84 electron

Synthesizer chip keeps sidebands 90 dB down

A monolithic CMOS IC that contains almost all the circuitry needed for a frequency synthesizer delivers both excellent noise performance and fast reaction. In a well-designed circuit, the NJ8820 synthesizer controller can hold the sideband to no more than 90 dB, with a lock time of a few milliseconds for a 1-MHz step.

The chip, from Plessey Semiconductors, needs a high-frequency (up to 1 GHz) modulo-2 prescaler, a VCO, and either some type of ROM

containing the channel information or a microprocessor to produce a universal binary-coded synthesizer. Microprocessor-compatible, the chip also interfaces directly with ROM or PROM.

Included on chip are a reference oscillator, 12-bit programmable reference divider, digital-output and sample-and-hold phase comparators, 10-bit programmable N counter, 7-bit programmable A counter, and circuits to accept and latch the input data.

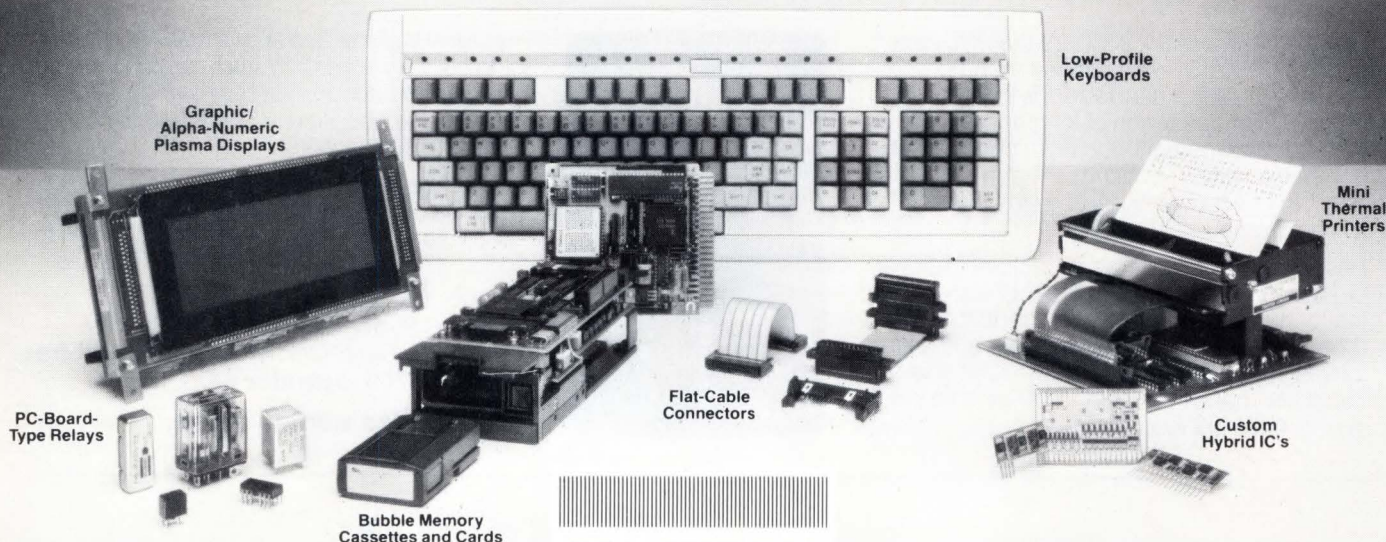
Data is presented as eight 4-bit words. Timing signals for the read operation may be generated internally or under control.

The supply voltage for the IC, which accepts inputs of over 10 MHz, is $5 \pm 0.5V$; the maximum supply current is 5 mA. It is housed in a 20-pin DIP or a 24-pin leadless chip carrier.

Plessey Semiconductors Ltd., Cheney Manor, Swindon SN2 2QW, England; (0793) 36251; Telex: 449637.

CIRCLE 520

Fujitsu: World-Class Components



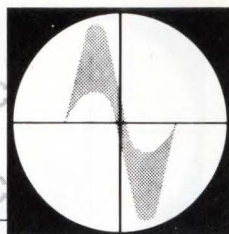
FUJITSU

CIRCLE 67

World-Class Components
 Part of Tomorrow's
 Technology

Component Division Fujitsu America, Inc.
 918 Sherwood Drive, Lake Bluff, IL 60044
 (312) 295-2610 Telex: 206196 TWX: 910-651-2259

electronica 84 electronica
 a 84 electronica 84 elec
 electronica 84 electronica
 a 84 electronica 84 elec

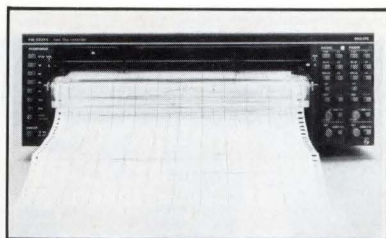


nica 84 electronica 84
 electronica 84 electror
 nica 84 electronica 84
 electronica 84 electror

Chart recorders have 15 ranges

Two chart recorders from Philips have 15 measuring ranges, from 1 mV to 50 V full span. The sensitivity of the single-line PM 8251A and dual-line PM 8252A may be varied from 0.95 to 2.5 times the selected range.

Recording is on a 250-mm-wide Z-fold chart, with a choice of 12 chart speeds, from 10 to 300 mm/min or mm/h. The zero line may be adjusted from -110% to +210% of span. Zero drift is less than $2 \mu\text{V}/^\circ\text{C}$, and the



deadband is below 0.2% of full-scale deflection.

The instruments' input impedance is $1 \text{ M}\Omega$, and there is no visible input noise even at maximum sensitivity. Other features include channel polarity inversion and an externally triggered event

marker. An analog output voltage provides an accurate readout of pen position and can be used for alarm or calibration checks.

The units may be mounted in 19-in. racks, with easy access for making notes on the chart. They are tested to 500 V ac and 700 V dc between terminals and earth ground.

Philips International BV, Scientific & Industrial Equipment Division, P.O. Box 523, 5600AM Eindhoven, the Netherlands; (040) 757005; Telex: 51573.

CIRCLE 524

World-Class Components Update:

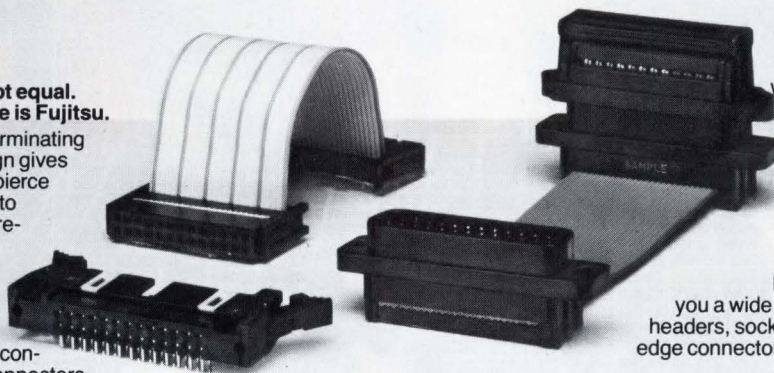
FLAT CABLE CONNECTORS

All IDC flat-cable connectors are not equal. There is a difference. The difference is Fujitsu.

For example, take the U-contact for terminating the flat cable. Fujitsu's exclusive design gives you four cutting edges. These edges pierce the insulation twice in the same place to make certain the insulation has been removed where the U-contact makes connection to the flat cable. Fujitsu's U-contact maintains very tight tolerances to ensure the reliability of the

connection between the flat cable and the connector. Fujitsu IDC connectors will accept 28 AWG stranded or 30 AWG solid wire.

Another example of Fujitsu's reliability is our own dual beam contact design. This design assures you a positive contact



with the mating connector every time. The connector housings and other insulating parts are fabricated from a flame-retardant, UL94V-0 rated PBT. This plastic resin—used in the insulating connector components—is impervious to chemical cleaning agents.

Fujitsu's FCN-700 Series offers you a wide variety of connectors, including headers, sockets, transition connectors, card edge connectors, a full line of D Subminiatures and Delta ribbon connectors.

Fujitsu connectors have all been designed to provide superior reliability as interconnect devices in electronic equipment, and they're all described in our literature. Circle the number shown below and we'll send you a copy.

For World-Class components at competitive prices, choose Fujitsu. Call your Fujitsu distributor today.



FUJITSU

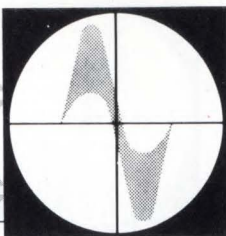


World-Class Components
 Part of Tomorrow's
 Technology

CIRCLE 68

Component Division Fujitsu America, Inc.
 918 Sherwood Drive, Lake Bluff, IL 60044
 (312) 295-2610 Telex: 206196 TWX: 910-651-2559

electronica 84 electronica
 a 84 electronica 84 elec
 electronica 84 electronica
 a 84 electronica 84 elec

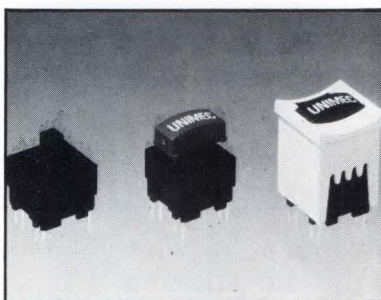


electronica 84 electronica 84 el
 electronica 84 electronica
 electronica 84 electronica
 electronica 84 electronica

Toggle switch offers 5 contact types

A toggle switch from A/S MEC contains all the contacts needed to give five contact arrangements: two changeover (double-throw), two make, two break, two make and two break, and reversed polarity. The arrangement is determined simply by selecting the appropriate switch terminal on the pc board traces.

The switch is 10 mm high, for use in 2.54-mm-grid pc board mounting. All contacts are made of 0.006-mm silver-



plated brass, with gold plating available on request. The contact resistance after 1 million cycles, the switch's minimum guaranteed lifetime, is typically 20 mΩ, and contact

bounce is less than 1 ms.

The keys, knobs, and bezels come in a choice of 10 colors to allow color coding, and up to four rectangular or pinhead LEDs may be incorporated in any one switch.

The Vario-Support, a matrix system in any cell combination of 1 by 1 to 10 by 10, it minimizes pressure and enables the switches to be mounted on a front panel.

A/S MEC, PO Box 26, DK-2750 Ballerup, Denmark; (02) 973366.

CIRCLE 521

MOLDED T-1 $\frac{3}{4}$ LED MOUNTS STRAIGHTEN UP AND SHINE BRIGHT.

Choose from 32 sizes in a T-1 $\frac{3}{4}$ LED Mount that makes assembly easy. Standoffs allow for cleaning, inspection, heat dissipation and proper filleting.

Available from stock in heights from .050" through .350" in .010" increments.

A bright idea.

"SEE US AT WESCON
 BOOTH 3743"

Bivar

BIVAR, INC., 4 Thomas, Irvine, CA 92714 Phone (714) 951-8808

Provides firm, straight support.

Totally symmetrical with funnel shaped lead entries.

NYLON with a U.L. rating 94V-2.

CIRCLE 69

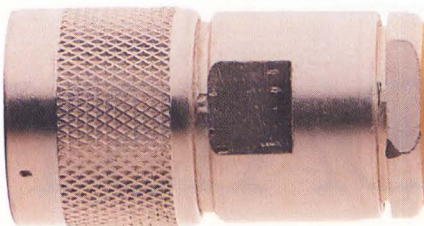
Four reasons why the Personal LOGICIAN is the ideal personal CAE workstation:



1. High performance design entry:

2. IBM® PC included.

3. Priced to fit every desk.



4. Integrated into the Daisy

Distributed access to the most powerful CAE tools on the market.

Consider the benefits of a *networked* Personal LOGICIAN, always ready and available, on *every* engineer's desk.

Personal access to a desktop Daisy workstation for design entry, documentation, and engineering support. No sharing. No waiting.

Network access to the most powerful CAE tools on the market for acceleration of every design step — concept through layout.

Complete CAE support through all phases of the design cycle, for better productivity, less tedium, and faster development.



Personal LOGICIAN™

The workstation for every engineer.

Integration of Daisy CAE technology and the IBM personal computer. We've added high-resolution graphics, high performance design entry, and network access to the standard in personal computing.



LOGICIAN™

The cornerstone of the Daisy product line.

The industry's best selling, best proven CAE workstation, providing full CAE functionality for design entry and design verification—and included in every high-level Daisy system.



MegaLOGICIAN™ and PMX.

Total system simulation.

Accuracy and simulation acceleration combine to deliver *reliable* verifications at *interactive* speeds.

The PMX (Physical Modeling Extension) allows system designers to incorporate complex devices and subsystems as part of entire system simulations.

DAISY

Engineering Environment.™

Your entire department works with a common set of connected tools and a common design database—minimizing your training and learning curve requirements as you add CAE capabilities to your design network.

And the network provides communications, for faster, more coordinated *team* efforts.

You can start with a single \$17,000 system. (You can even upgrade your existing PC-XT for \$12,000.) Deploy the workstations where and how the resources are required.

We can personally attest to the engineering acceleration you'll get when every engineer has a personal workstation. We know. Today, *every* Daisy engineer has a Daisy, on a Daisy network.



GATEMASTER.™

The standard semicustom workstation.

The system for optimal semicustom design and *correct by construction* layout. With more design libraries on line than any other system, GATEMASTER puts semicustom technology within the reach of any design engineer.



CHIPMASTER.™

Next-generation mask layout.

Integration of CAE and CAD in a single system. Performance acceleration means layout now runs at interactive speeds, in a windowed working environment. Plus: Power and capacity for VLSI circuits of any size, any technology.

CIRCLE 72

Send me, for free:
Personal LOGICIAN
data sheet.

Daisy CAE Product
Line Literature.

Better individual
productivity.

Better team pro-
ductivity.

To find out more
about how the Personal
LOGICIAN's distributed CAE
solution can help you, please
call or write for information.

daisy
SYSTEMS CORP.

139 Kifer Court, Sunnyvale, CA 94086

408-773-9111, ext. 2287

IS ENGINEERING

Don't over-spec your next power supply.

With Sierracin, you don't have to go to the next higher power level or select two or more power supplies when only one is needed. That's because we provide the widest line of open frame dc power supplies to choose from.

Single and multiple output ... switching or linear from 2.5 to 500 watts. With so many models you won't over-spec or overprice yourself ever again.

No one switching technology can be stretched over such a wide power range to deliver economical solutions. That's why we're the only power supply manufacturer using four different technologies... Flyback, Half-bridge, Flyforward™ and Push-forward™.

Therefore, no high component stress levels... no exotic devices... no complex circuitry. And we comply with VDE, FCC, UL and CSA for safety and EMI. A unique Sierracin feature is the "output good" LED indicator. No ac power, no light... OVP fires, no light... saves you troubleshooting time.

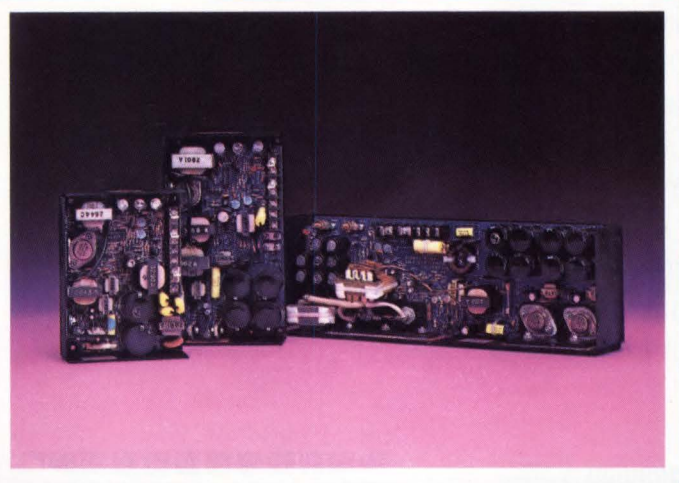
Best of all, Sierracin power supplies are in stock... here or at your local distributor. Ask for our "Widest Line" catalog. Or check EEM or Gold Book. For on-line applications information dial toll-free outside California (800) 423-5569. Sierracin/Power Systems, 20500 Plummer Street, Chatsworth, CA 91311. Phone (213) 998-9873.

Sierracin is
where it's happening
in power supplies.



Sierracin/Power Systems

CIRCLE 73



CAREER SURVEY

1984

Large numbers of engineers say they are not wholly satisfied with their career, so reveals *ELECTRONIC DESIGN'S* 1984 Career Survey. Nearly half of our readers have at one time or another considered changing their profession, and many dream of someday owning their own business. Yet despite these grumblings, most exhibit remarkable loyalty toward their employer—enough to cancel their vacation plans if they are needed at work.

Money does not appear to be at the root of the discontent. According to the survey data engineers are not only keeping ahead of inflation, they are outpacing it by almost three to one. Further, employers in general have not skimped or delayed when it comes to salary increases; nearly all of our readers have gotten a raise

CAROLE PATTON

within the past year.

But engineers and engineering managers both devote office time to low-level tasks like typing or filing—unfulfilling jobs that do not quite jibe with the vision they may have had of engineering during their school days. Both groups also spend a hefty chunk of their personal time worrying about job responsibilities.

Further, the very nature of engineering work appears to be changing. Many readers tell us that their job now requires knowing something about computers and software, skills that they say are not taught adequately in engineering schools.

The survey data draws on a random sampling of 2000 engineers and engineering managers, of whom 638 responded (although 73 returns arrived too late for inclusion). All

told, 475 engineering managers, 138 engineers, and 29 general and corporate managers gave their opinions. Most calculations have been rounded off, meaning that the sum of all percentages in some categories may total slightly more than 100%.

Without question, salary levels are the primary points of interest in any career survey. The average gross wage of the engineers and managers comes in at \$47,210, with a median of \$47,070. Engineering

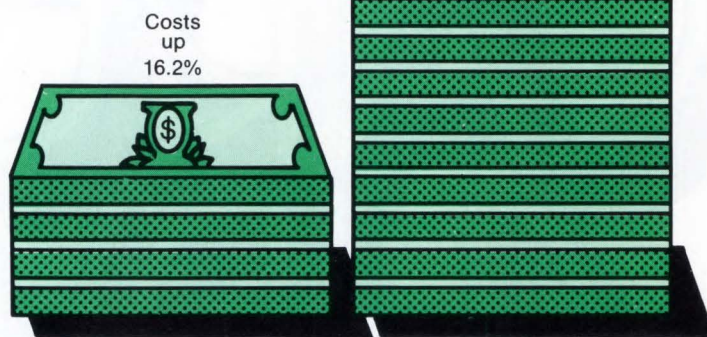
managers averaged \$48,300 and engineers \$42,820.

Back in 1978 our readers earned a median annual income of \$26,502; in 1981, \$32,500; and this year, \$47,070. The difference between 1978 and 1981 was \$5898—a 22% increase. But over those same three years the Consumer Price Index rose by 32.8%.

On the other hand, the difference between 1981's and 1984's figures—\$14,570—represents a 44% increase, and the Consumer Price Index rose only 16.2% over the past three years (Fig. 1). The net result is, more "real" dollars.

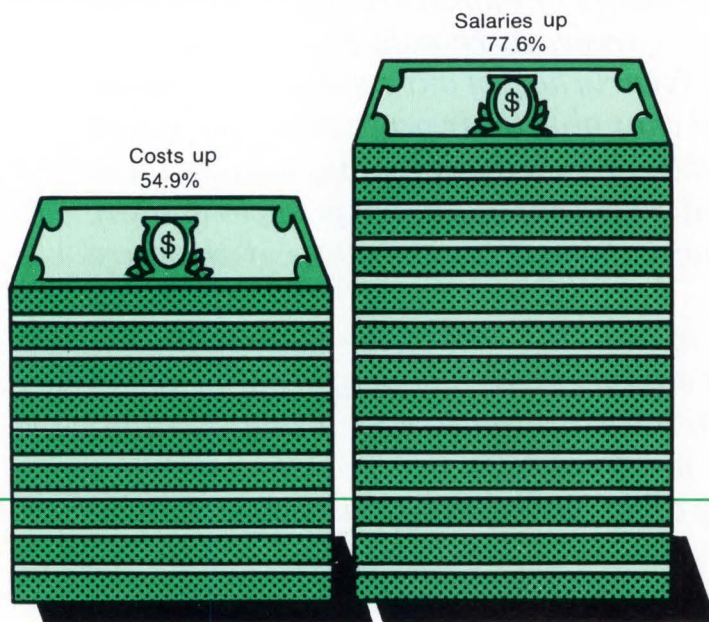
In fact, from 1978 to today costs rose by 54.9% but salaries (mainly due to gains over the past three years) outpaced them, rising 77.6% (Fig. 2).

Of course, arithmetic averages do not tell much about who is making what. Take a look at annual salaries by job function:



Costs vs salaries: 1981-1984

Figure 1



Costs vs salaries: 1978-1984

Figure 2

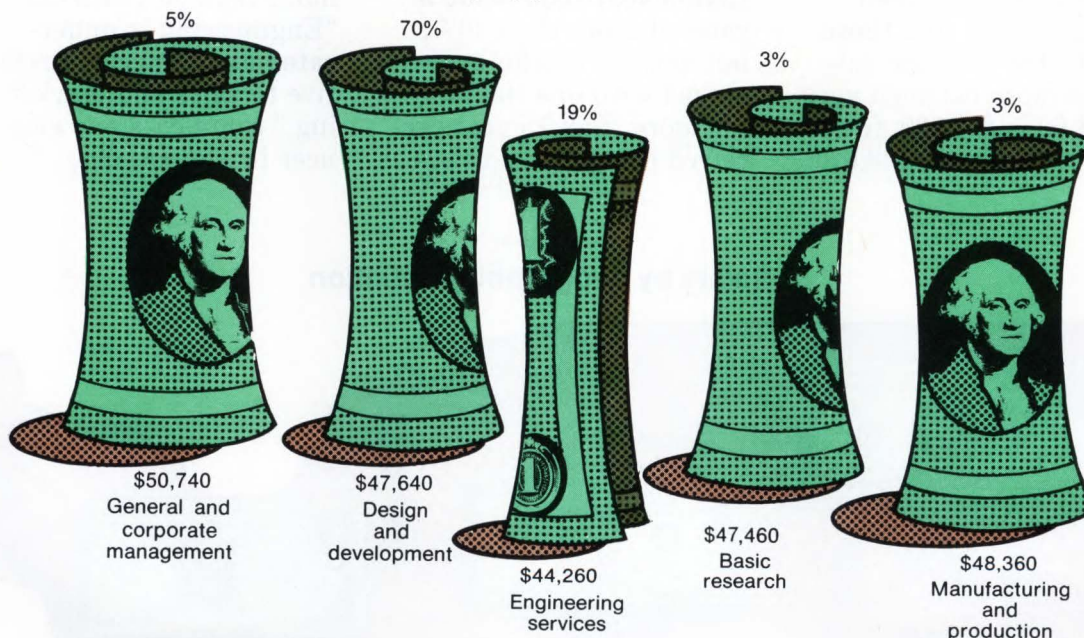
Corporate managers top the chart (\$50,740), closely followed by engineers in manufacturing and production (\$48,360) (Fig. 3). Respectively, however, those two groups represent only 5% and 3% of the respondents. Engineers and engineering managers in design and development, representing

Northwest seems to be paying higher salaries than any other area (\$50,900), with the Southwest in hot pursuit (\$49,610). Interestingly, salaries in the Northeast and Midwest converge (\$45,540 and \$45,300 respectively), whereas those in the Southeast lag behind the other areas

cross-tabulating the raises reveals that the amount of the increase drops steadily with age—from 8.06% for people 20 to 30 years old to 6.16% for those over age 60 (Fig. 6). Companies usually rationalize that by explaining that older employees already earn a high salary. But the survey refutes that: Engi-

Figure 3

Salary by job function



70% of all respondents, earn the next highest salary, \$47,640. Trailing them slightly are those working in basic research (\$47,460) and engineering services (\$44,260).

From a geographical perspective (Fig. 4), the

(\$43,970).

Fully 91% of our readers have seen their salary rise 7.28% within the past 12 months (Fig. 5). However, not all enjoy economic gains; older engineers are hit hard by salary compression. In fact,

needs over 60 actually earn \$3860 less annually than their colleagues who are 10 years younger.

Consider the salary differentials; that is, the difference between salaries in each age group (Fig. 7). Between ages 20 and 30,

engineers and engineering managers earn \$35,190; between ages 30 and 40, they receive \$43,950. The \$8760 difference gives the second group 24.8% more a year. The earnings difference between 30 to 40 years and 40 to 50 years drops to 14.3% and between the latter group and engineers and managers of 50 to 60 years old, the differential is 4.5%. Most striking is the difference between that last group and those over 60. The average salary for those between ages 50 and 60 is \$52,530; for the over-60 group, \$48,670.

The differential plummets to -7%.

Though engineers, like other professionals, can expect an annual raise, the odds of getting a big raise—one of 10% or more—fall the longer an engineer stays with the same company. In fact, a seemingly disproportionate number of engineers (43.9%) who have worked for their company less than a year took home a raise of more than 10%, but only 8.7% who have stayed with one company for more than 15 years received comparable raises

(Fig. 8). Nearly a quarter of our respondents admit that they bolster their regular income with some kind of outside work, and 30% depend on a working spouse to maintain their style of living.

When asked how they rate their salary, a full 42% of the engineers think they should be making more, with 57% of the dissatisfied ones being more than 40 years old. "Engineering is under-rated and underpaid relative to sales and marketing," comments one engineer in his mid-50s,

Figure 4
Salary by geographical location

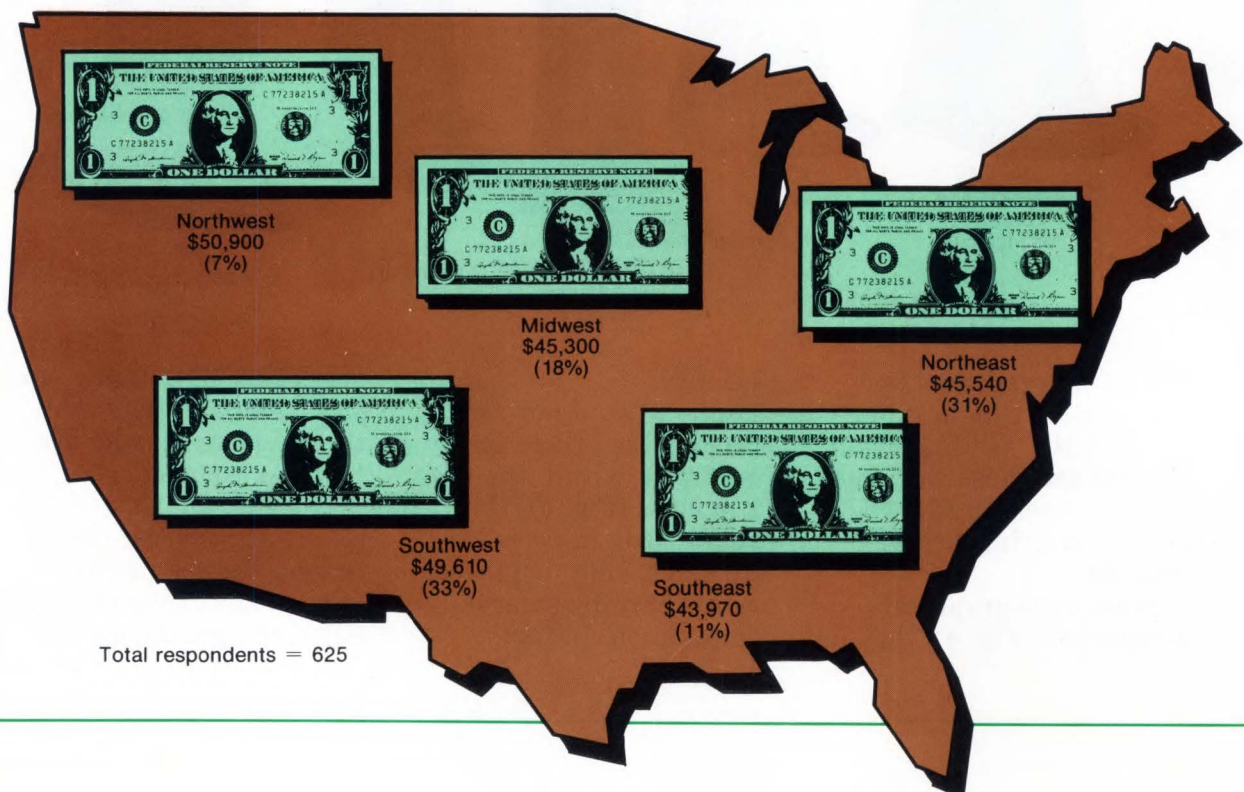
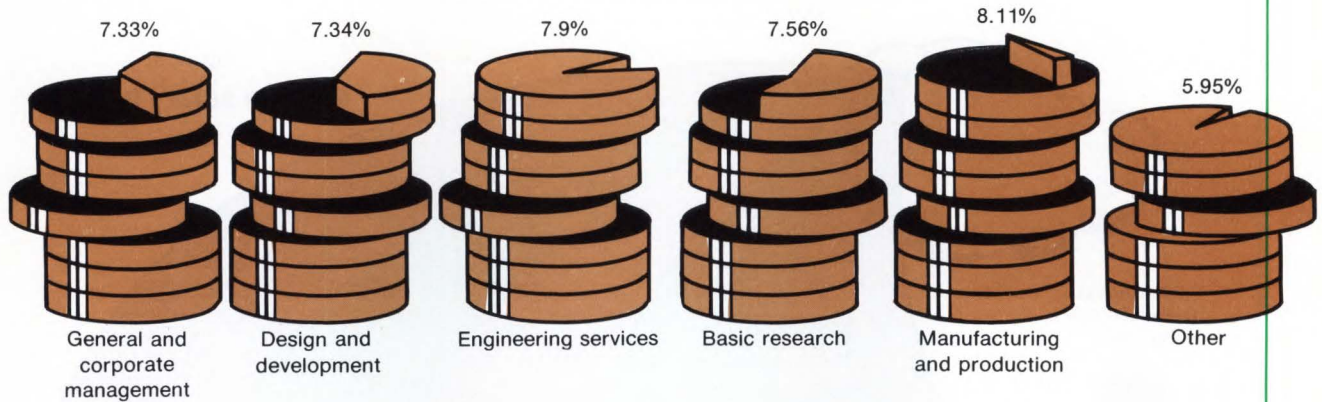


Figure 5

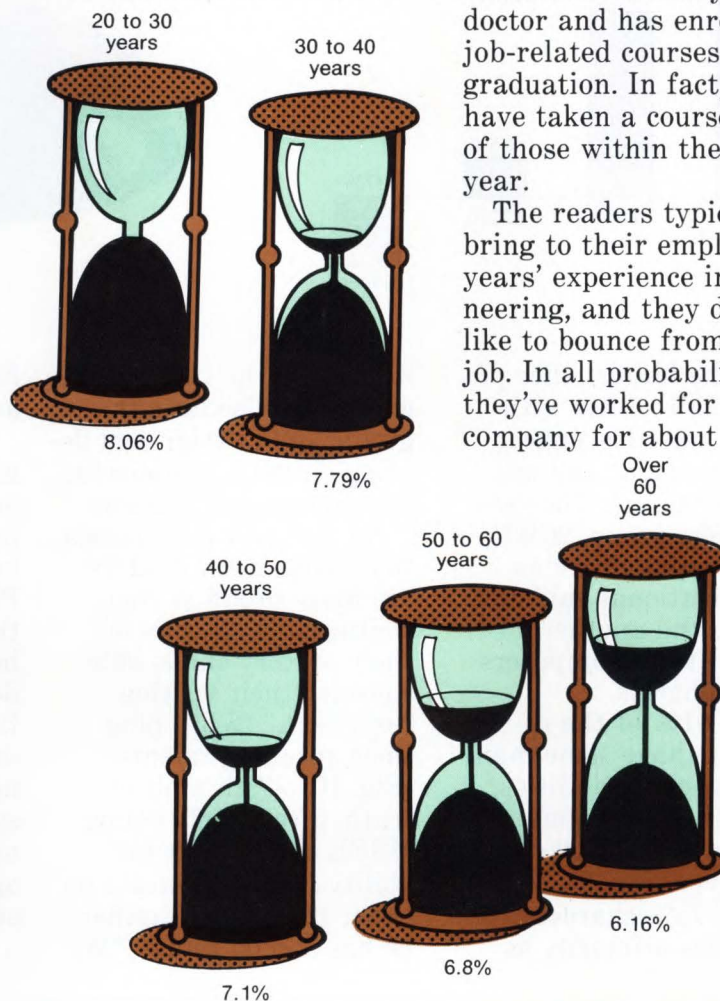
Salary increases by job function

whereas a relative "youngster" in his mid-30s worries about wage compression and the cyclical nature of engineering employment.

Fewer than half of the respondents are vested in a company pension plan, and another 34% do not plan to vest. Two-thirds have invested in an IRA or a Keogh plan, and an equal number are preparing for retirement through savings and personal investments. But 18.8% have not saved for retirement at all.

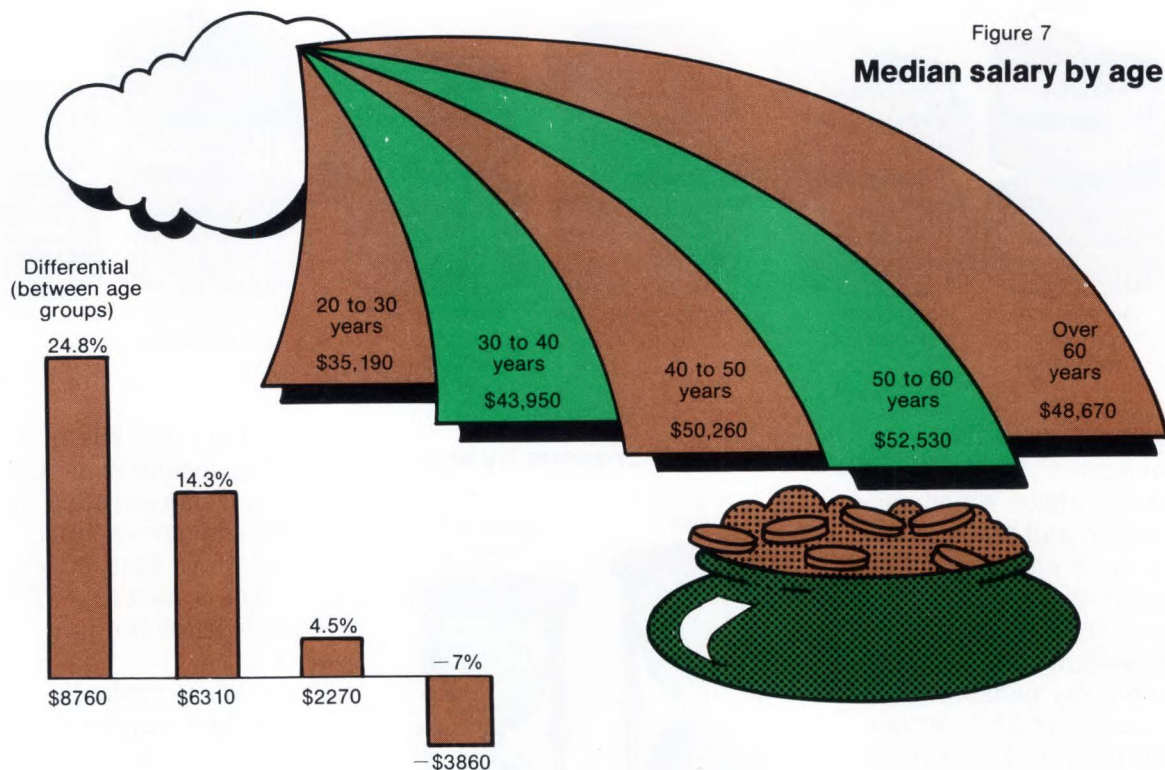
The "average" reader of *ELECTRONIC DESIGN* is a 43-year-old male who is not at all average. (Only 10.2% are 30 years old or younger, and only one woman responded to the survey.) He is an American citizen who has a bachelor's degree in engineering. (More than a quarter have gone beyond to earn at least a master's

Figure 6

Salary increases by age

degree). He takes his profession as seriously as any doctor and has enrolled in job-related courses since graduation. In fact, 90.5% have taken a course, 47% of those within the past year.

The readers typically bring to their employer 12 years' experience in engineering, and they do not like to bounce from job to job. In all probability, they've worked for one company for about eight



years. The largest slice of the pie, 25%, deals with aircraft, missiles, space, and government and military electronics. The second largest group, 20.9%, makes communications and navigational guidance systems, and another 13% concentrate on computers and peripherals.

A full 91% of the respondents have some management responsibilities, with only 6.6% claiming no management tasks whatsoever (Fig. 9). Interestingly, 75% characterize themselves primarily as

managers, the rest as engineers. The largest group, 70%, design and develop circuits, components, equipment, and systems.

As for their communication skills, most readers are more proud of their writing talents than of their oratory skills: 39% consider their writing "excellent," 28.8% plug their speaking talents (Fig. 10). With a bit of truth, a relatively young MSEE claims that his ability to communicate on paper hinges on whether he has a good typist. "My

handwriting and spelling are terrible," he explains.

The engineers and engineering managers have no overwhelming feelings for professional societies: 51% belong to one, 49% do not. Perhaps in keeping with their management status, however, they definitely do not belong to a union. In fact 67% are against unions, but 27% remain neutral. (One engineer sympathizes with some union aims but stands against "quotas and seniority.")

Not surprisingly, when

Figure 8

Salary increases by length of service

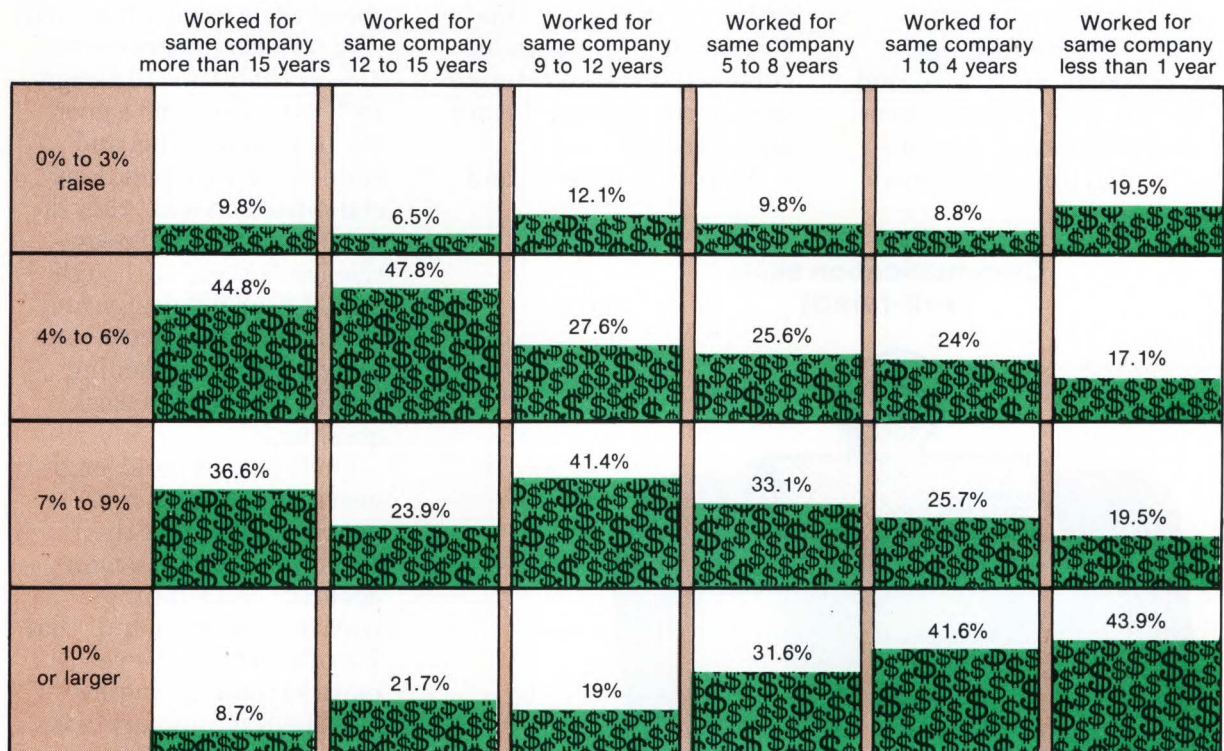
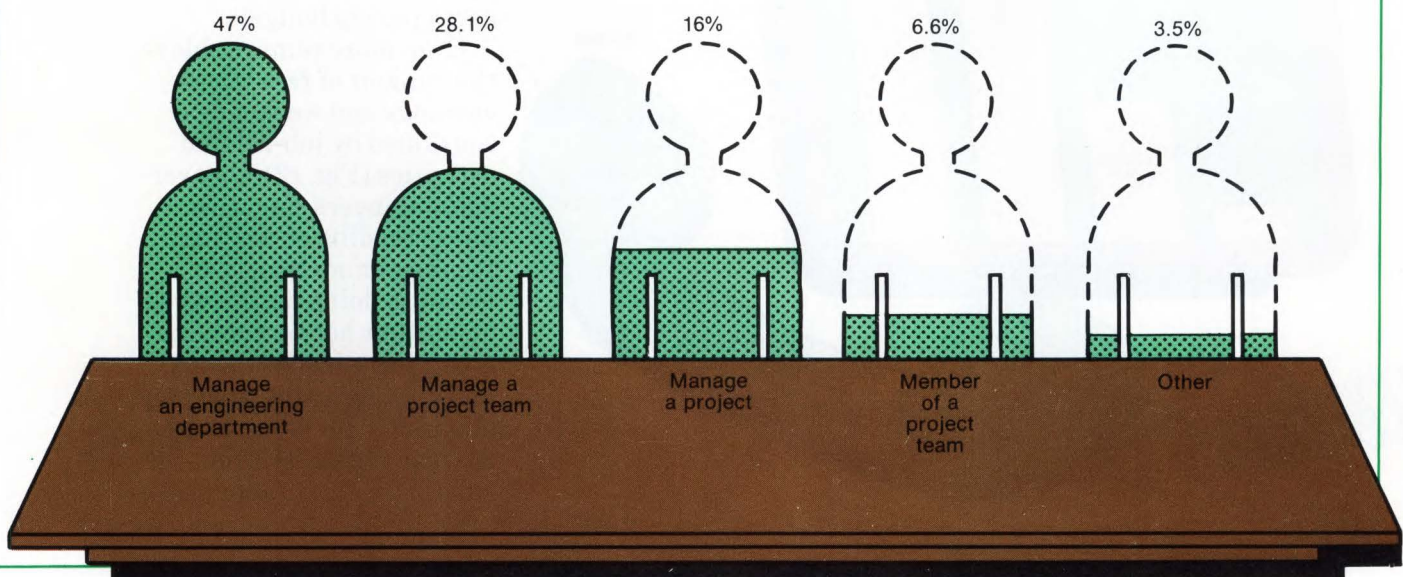


Figure 9

Job function



Total respondents = 633

engineers turn their attention to hobbies, they primarily list nontechnical ones: sports, art, travel, and the like. Nevertheless, some could not answer the question easily; one questioned

whether photography is technical or artistic. One 30-year-old MBA pegs his outside interests as stereos and sports, adding, "I can't afford travel."

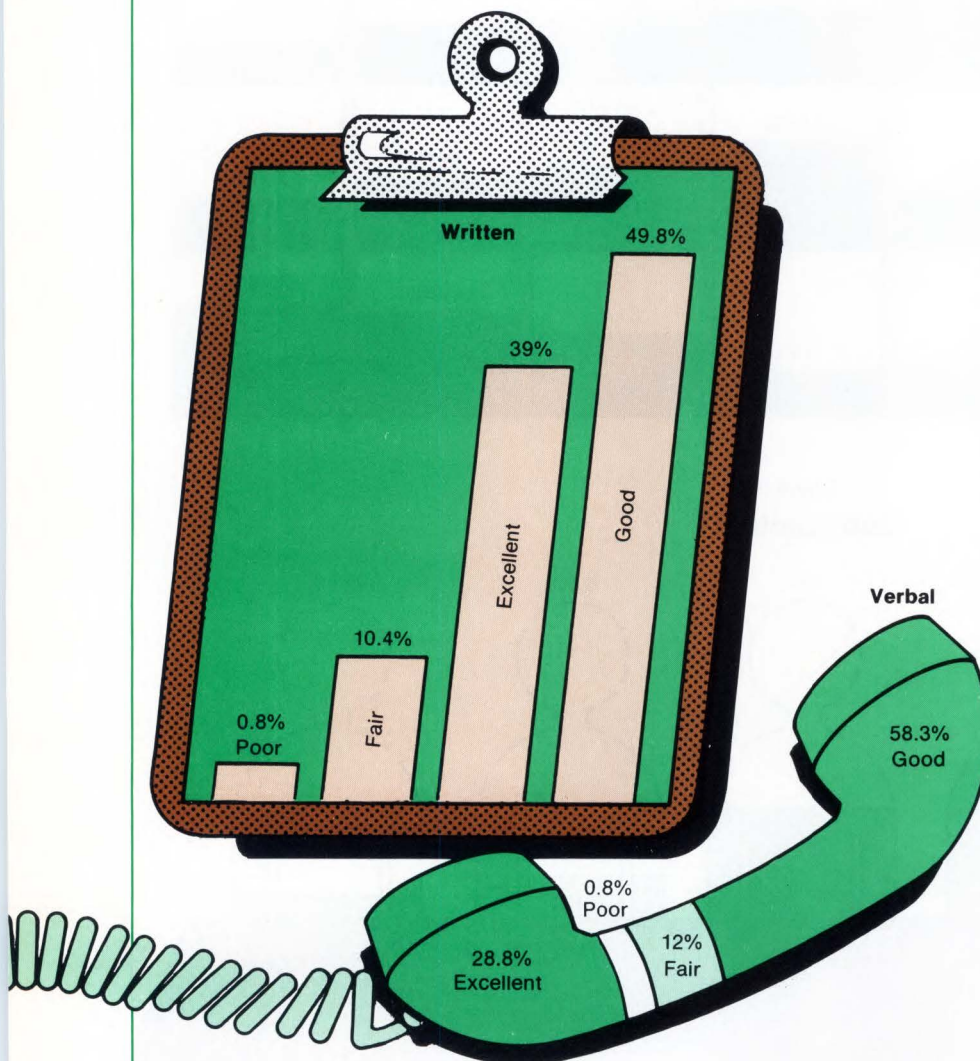
At work, engineers and

engineering managers spend their week differently (Fig. 11). Engineers devote 21% of their time to design, 10% to testing, and a good 6% to typing, filing, and running photocopies. Few elaborated on what they do during the period categorized as "other," although one 30-year-old design and development engineer candidly admits to spending "about five hours a week gossiping."

On the other hand, engineering managers give nearly a quarter of their work week (22%) to management and administrative tasks but admit that 7% of their time—even more so than for engineers—is spent on support tasks. Both groups turn thumbs down on formal meetings (41%), support tasks (27%), and such management and administrative (22%) jobs as preparing budgets.

Even more remarkable is the amount of free time—evenings and weekends—consumed by job-related activities (Fig. 12). On average, engineers spend six hours reading or writing technical material, five hours on doing design work, about four hours worrying about technical problems, and another three worrying about management. Even a 20-year-old BSEE from the Northeast frets "about tech-

Figure 10
**Communication skills
(self-rated)**



nical and management responsibilities constantly." Engineering managers take their work home too, spending the equivalent of one working day worrying about technical and management-related problems.

On a related matter, nearly half of those polled read trade magazines to stay current with technological advances, and a slightly smaller group depends on job assignment to keep up-to-date technically (Fig. 13). One respondent lists his learning tools as "self-study using industry-related books, hardware, and software."

The overwhelming majority of our readers—85%—originally chose engineering as a career because it met their own interests. A smaller number—13%—entered the field because they thought it would pay well, and a few picked the profession because a friend or relative was an engineer. One reader credits his military training for the choice, a 60-year-old BSEE chalks up his career to "parental prodding," and a 40-year-old MSEE in communications based the decision on "government forecasts."

Though 54% of the engineers we polled are satisfied with their career and 7% are dissatisfied, a 39% group falls somewhere in

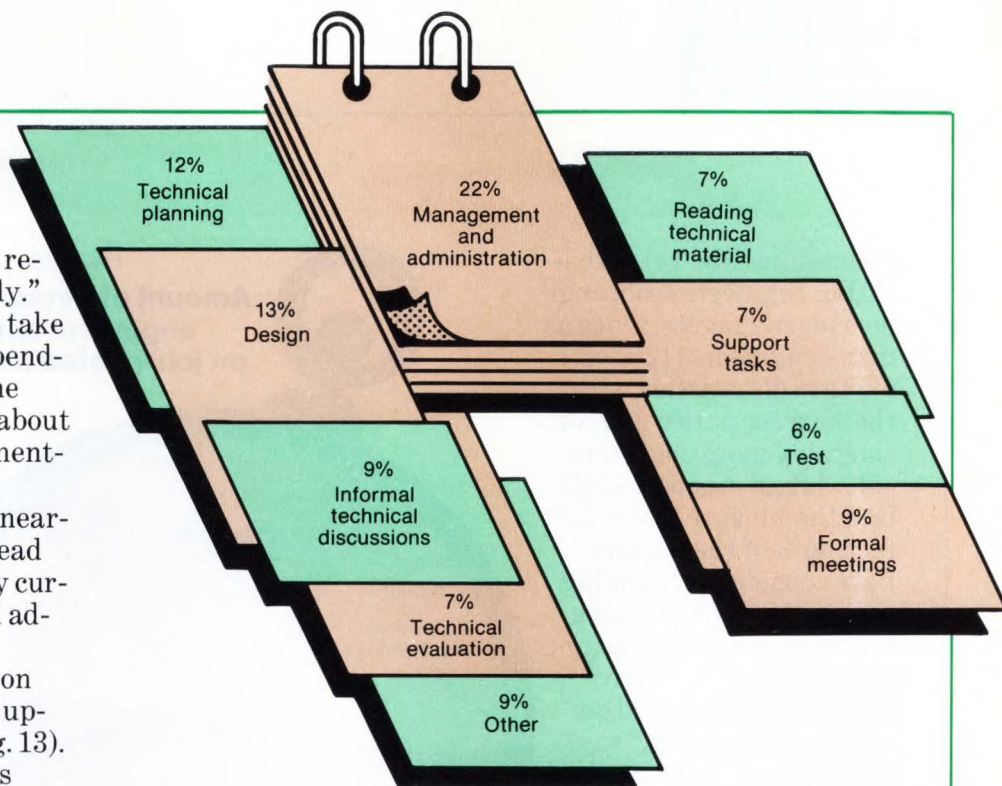


Figure 11a

How engineering managers spend their work week

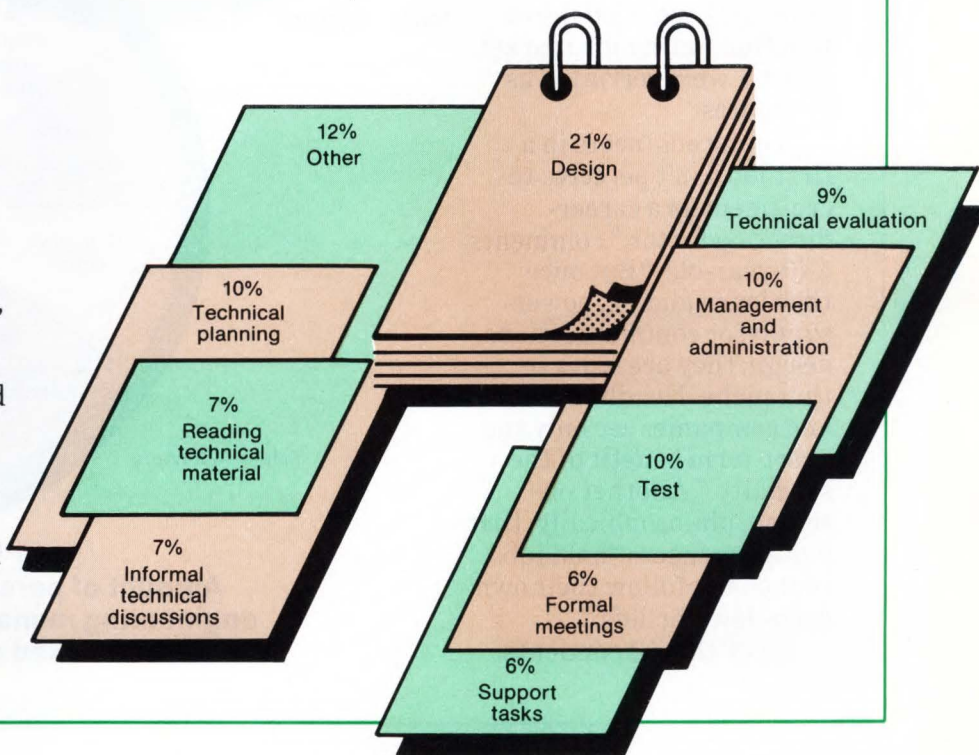


Figure 11b

How engineers spend their work week

the middle (Fig. 14). Separating engineers from engineering managers, twice as many engineers (12% vs 6%) are dissatisfied with their career paths, and considerably more engineers (44%) than managers fall into the "unsure" zone. In fact, 46% of the readers have considered changing their profession. Remove the managers, and the figure rises to 51%. "I have three sons that would do well in engineering," says one engineer, "but I do not encourage them."

Freedom of choice appears more limited when it comes to an engineering specialty. Though the majority selected their specialty because they liked it, another 18% were led into it by a fluctuating job market, and 9% were recruited as graduates.

"Young engineers in a first job don't perceive recruitment as a career-directing factor," comments a 40-year-old. "But once they learn analog, power-supply, or communications design, they are stuck in that niche. Headhunters and companies see only the short-term benefit of the specialty." Another observed, philosophically, that many engineers "hold jobs that do not follow their own, deep-down beliefs."

All of the respondents

Figure 12a

Amount of personal time engineers spend on job-related activities

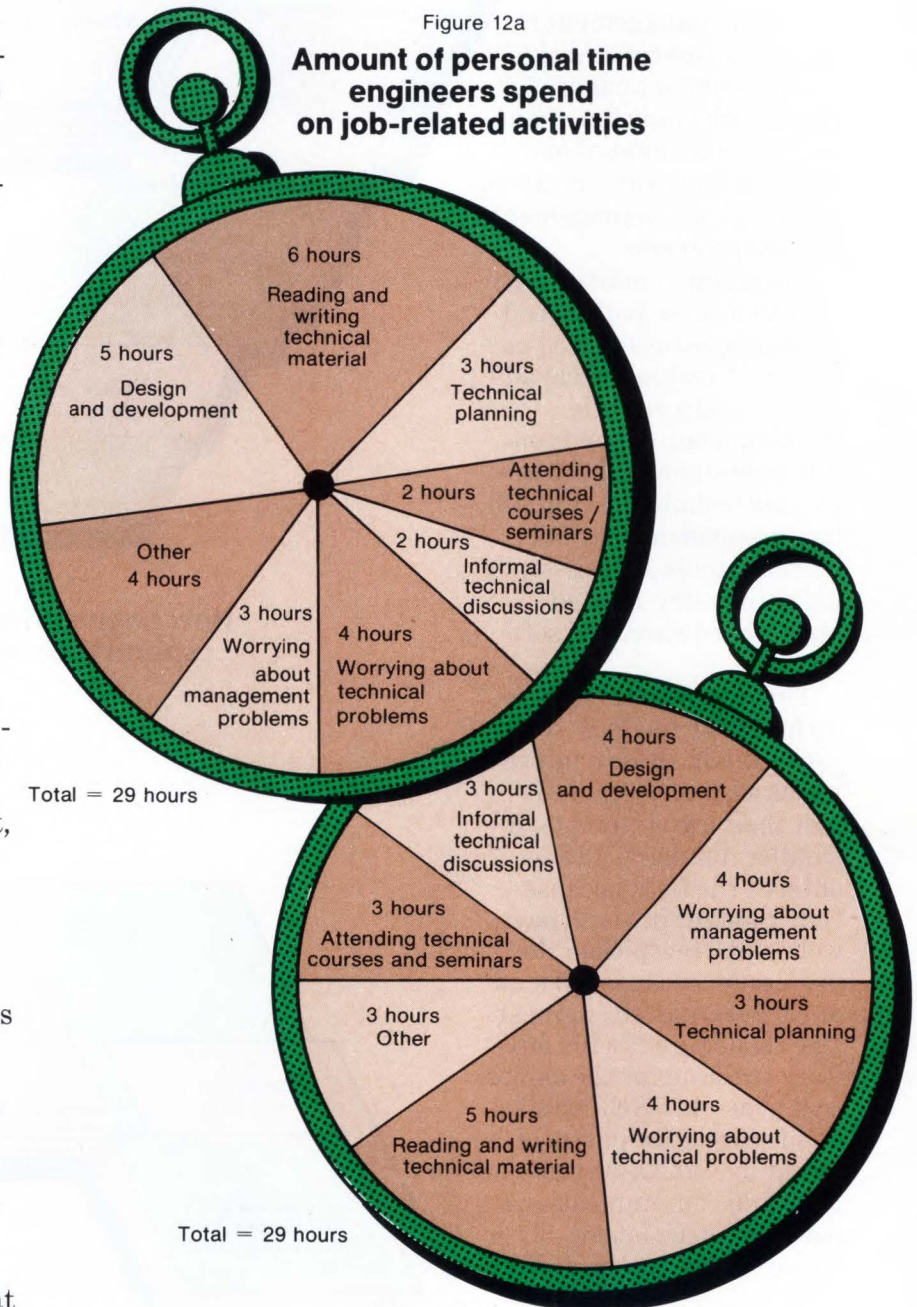


Figure 12b

Amount of personal time engineering managers spend on job-related activities

would look for certain factors to make their career more satisfying, 22% singling out owning their own company (Fig. 15), "I wasn't happy until I was an owner," says a 40-year-old Southeasterner, adding "I don't think I could ever work for anyone else again." One of the older respondents approaches it from a different angle: "As a past entrepreneur now nearing retirement, I would not be interested in reinvesting my equities in the electronics industry."

More challenging job opportunities would entice 19%, and 18.6% admit to being happier if they made more money. But for some, the right atmosphere, not dollars, is the greatest source of satisfaction. "I'm tired of sell, sell, sell with no time to do, do, do," one complains. "Not having to work 70 hours a week would be nice," says a 30-year-old. With a bit more imagery, another respondent points out, "It would help if my managers understood that engineers are not desks; they don't like to be moved around."

A few are not at all happy with their chosen field. "Making an inert, unthinking collection of metal and sand appear intelligent is, to me, a total waste of time, energy, and money," la-

ments one. But for another, the key to satisfaction lies in "good coffee and not too many phone calls."

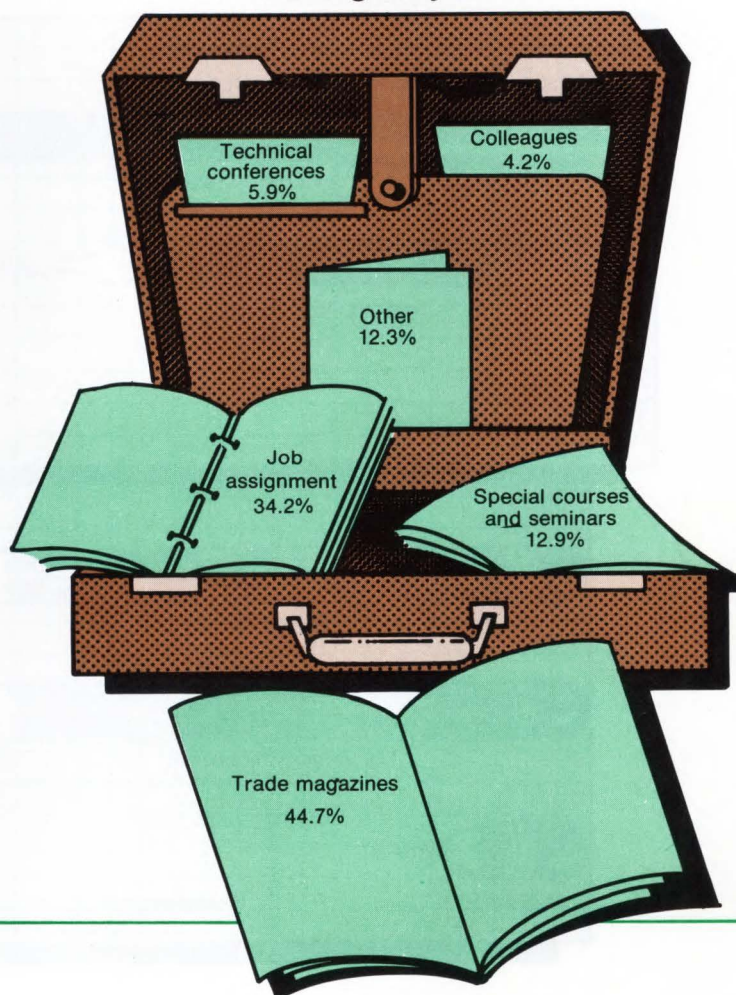
Job hopping holds no attraction for our readers. Fully 23% now work with the first company that hired them, 21% have changed jobs only once, and 33% have moved two or three times over the course of their career. Usually, job

hopping is considered neither fruitful nor worth the stress. "I've changed jobs based on promises of advancement that never materialized," admits one. "I found better advancement staying with one company."

Nevertheless, when our readers do consider changing jobs, a challenging job assignment is the most tastiest carrot to dangle. In

Figure 13

How engineers stay technologically current



fact, 44% named job challenge as the most important factor in switching companies. Better prospects for advancement appeal to 29%, and only 20% choose higher pay as a top priority.

As for what ranks higher—their personal plans or their jobs—respondents generally would be willing to cancel their vacation plans if they were needed at work (Fig. 16). In fact, 71% overall give

greater weight to their job. Engineers and engineering managers differ somewhat on their dedication, however, only 64% of the engineers would relinquish personal time, whereas nearly 73% of the managers feel the job takes precedence over their own plans. Several engineers are vehement about it: "Not only no, but hell no!" Adds another, "My family is my number one priority." A fourth has

cancelled plans in the past "but no more. How can anybody ever give me back that time?"

Much like the impact they have had in other fields, computers and software clearly are affecting the very essence of electrical and electronics engineering (Fig. 17). Nearly four out of five 20- to 30-year-olds hold a position that demands a knowledge of computers and software, and nearly half

Figure 14

Satisfied with engineering as a career?

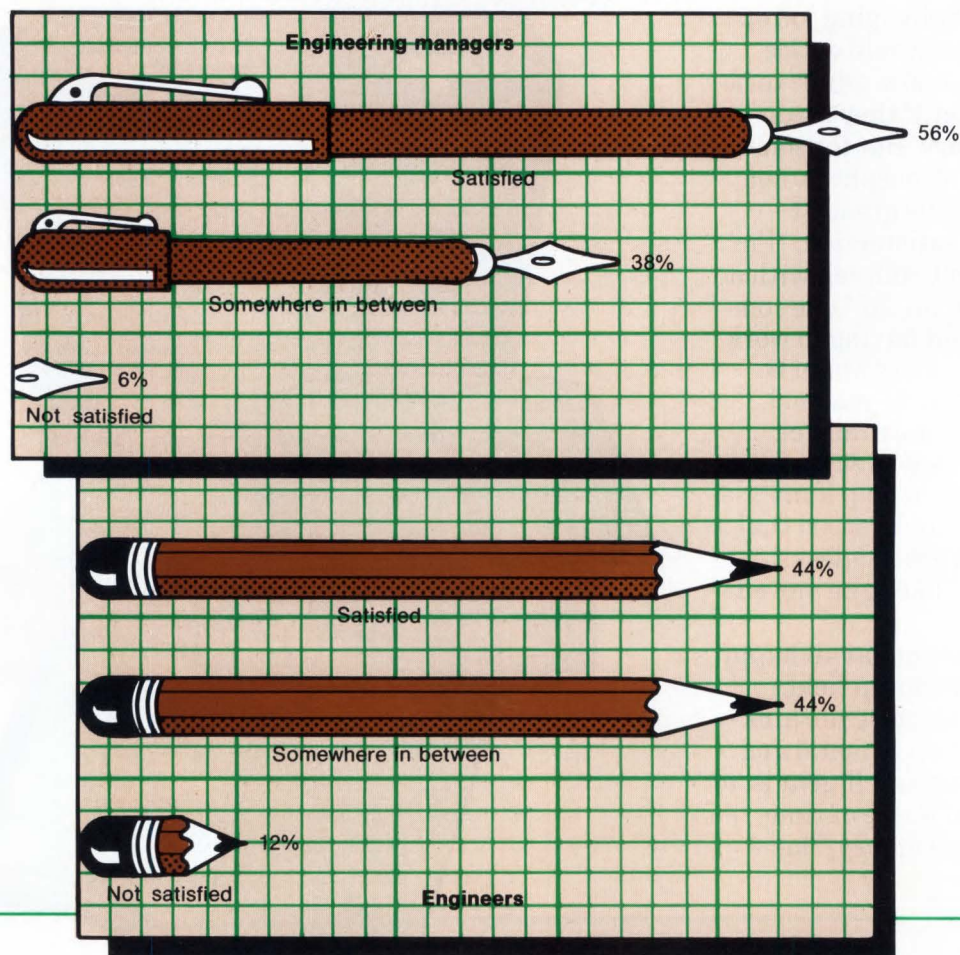
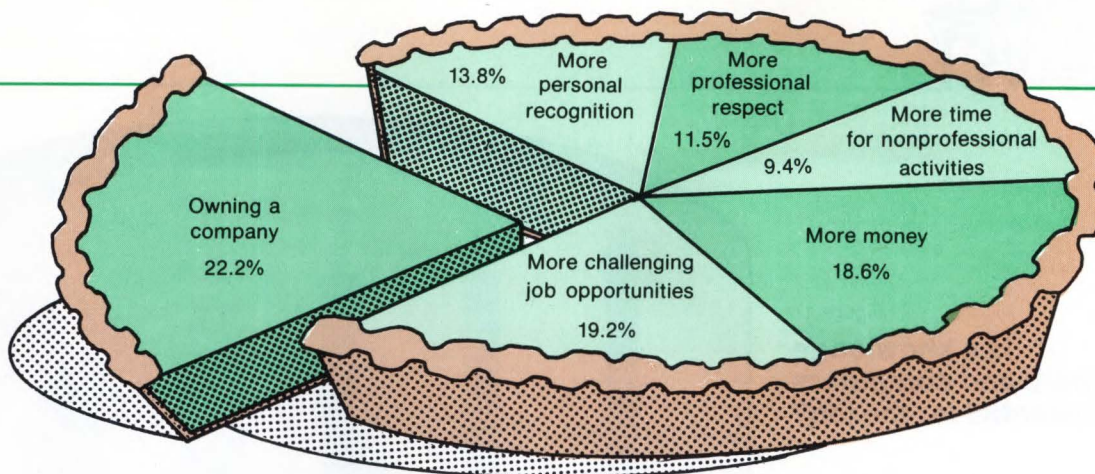


Figure 15

What would make engineering more satisfying?



the over-60 respondents find the knowledge a necessity.

Analog skills on the other hand are not in big demand (Fig. 18). Though 38.5% of the engineers age 20 to 30 have those skills, fewer than half of all ages consider them a job requirement. Despite the statistics, not everyone is willing to concede to a digital universe. Says one reader, "I think there is too much emphasis

on computers. My work—synthesizers—is entirely analog." To another, computers are "treated as an absolute fixation."

When asked how well their EE undergraduate education prepared them for their profession, the vast majority feel they have a solid background in basic mathematics and physics (Fig. 19). Yet many also consider their education lacking in digital design, soft-

ware, and programming. To be fair to the educational establishment, however, one 60-year-old MSEE—now working on his PhD at Stanford—points out, "Digital design didn't exist when I was an undergraduate."

Others, however, are not so gentle. "Engineers are being trained in skills that are 10 years behind the times," insists one. Engineering education is inadequate, ech-

How committed are they to the job?

Figure 16a

Engineering managers



72.8%
Would cancel
vacation

27.2%
Would not
cancel vacation

Figure 16b

Engineers



64.1%
Would cancel
vacation

35.9%
Would not
cancel vacation

Figure 17
Is a knowledge of software and computers essential for the job?

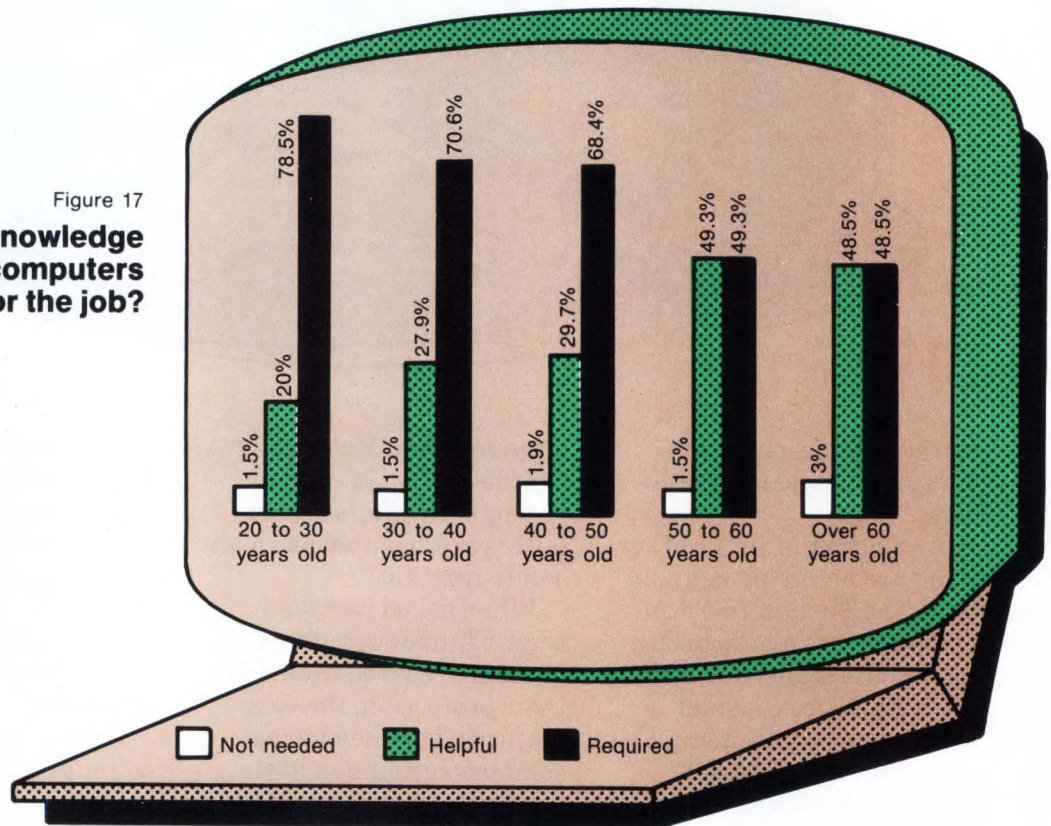
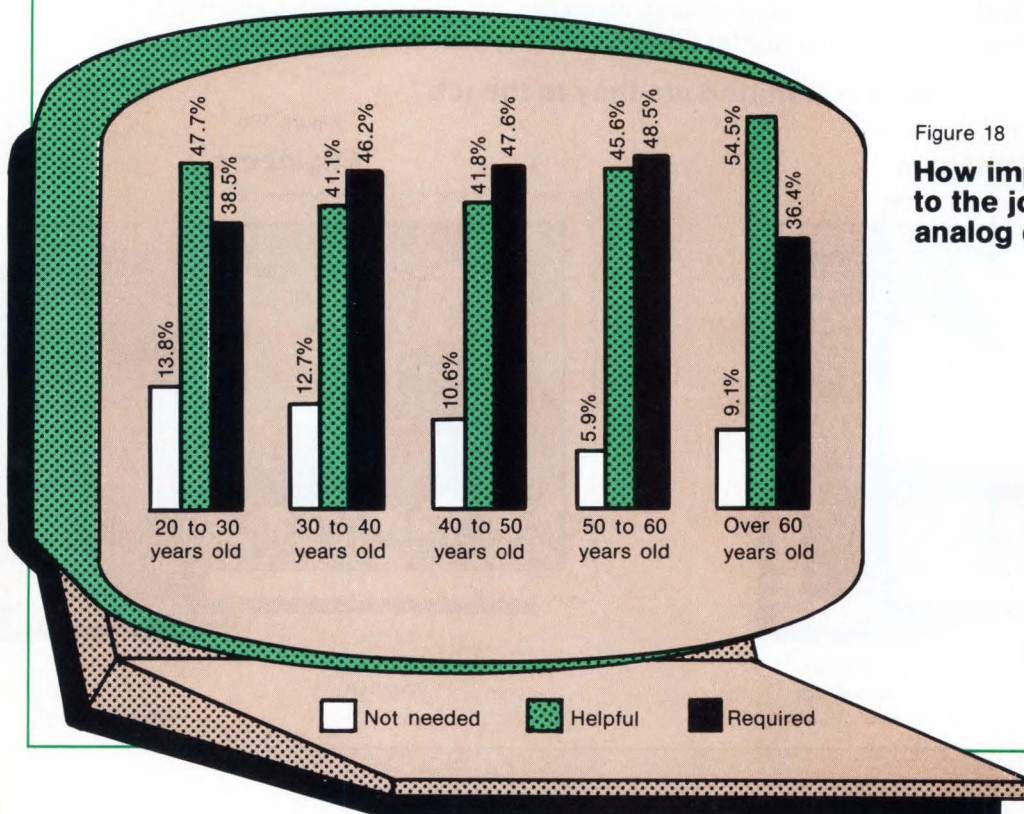


Figure 18
How important to the job is analog design?



oes another, adding, "Most professors have never been responsible for designing, building, and delivering a product to a customer within a cost budget." More pointedly, many complain that the engineering curriculum is poor and "doesn't prepare individuals for a real-world environment." Because engineers are not well rounded, they "do not relate to people," suggests another respondent.

As for what areas of study should be included in the curriculum, 56.8% single out courses in management, and 46% gripe about the absence of human relations skills (Fig. 20). Another 46% said they could have used some communications training skills.

Given a choice, our readers list history, literature, music, accounting, economics, public speaking, report writing, and even typing as valuable additions to an engineering curriculum. A 30-year-old engineering manager in communications systems would have liked courses in thermodynamics, and a 50-year-old from the Midwest wanted philosophy. Tongue in cheek, a young engineer in the Southwest says he would like to see a "goulash" course—a sort of "introduction to real-world engineering."

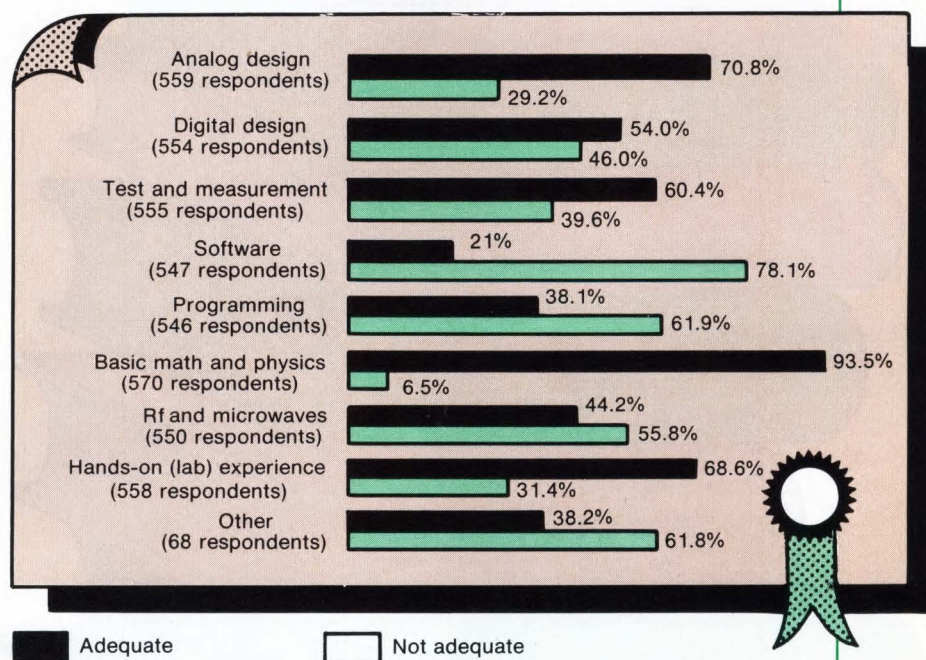
But facts and figures only tell part of the tale. We found a wealth of wide-ranging and freewheeling comments added to three-quarters of the responses we received. We heard what is wrong with America: crime, child abuse, high taxes, social security, too much welfare, a lack of sound fiscal practices in government—and the 55 mph speed limit! Readers decried the vanishing American work ethic: "Our workers are more interested in their Winnebagos and softball teams than in qual-

ity work." "Free lunches are only found in run-down taverns," one assures us. And we heard industry criticized for its "short-term, return-on investment mentality."

Most striking—considering the number of readers who directly or indirectly depend on the military for their livelihood—are the fears of nuclear proliferation and the threat of war. Dozens of respondents name a potential nuclear war as the most important social issue of the day. "People fail to recognize that to enjoy the good life,

Figure 19

Do engineers consider their EE undergraduate education adequate?



you first have to be alive."

More typically, others were concerned about career problems like "staying technical in a world that pushes engineers toward management" and seeking a true, dual-ladder system of advancement. Some complained that engineers are "devalued over newer professionals like programmers."

There were political concerns expressed as well.

Several lament the "mediocrity" among those in high political offices, and more comment about "Washington idiots." Another complained that not enough engineers are in leadership positions, because "people don't see engineers as problem solvers. Jimmy Carter was an engineer. Nice guy, but definitely not a leader."

Engineers, for the most

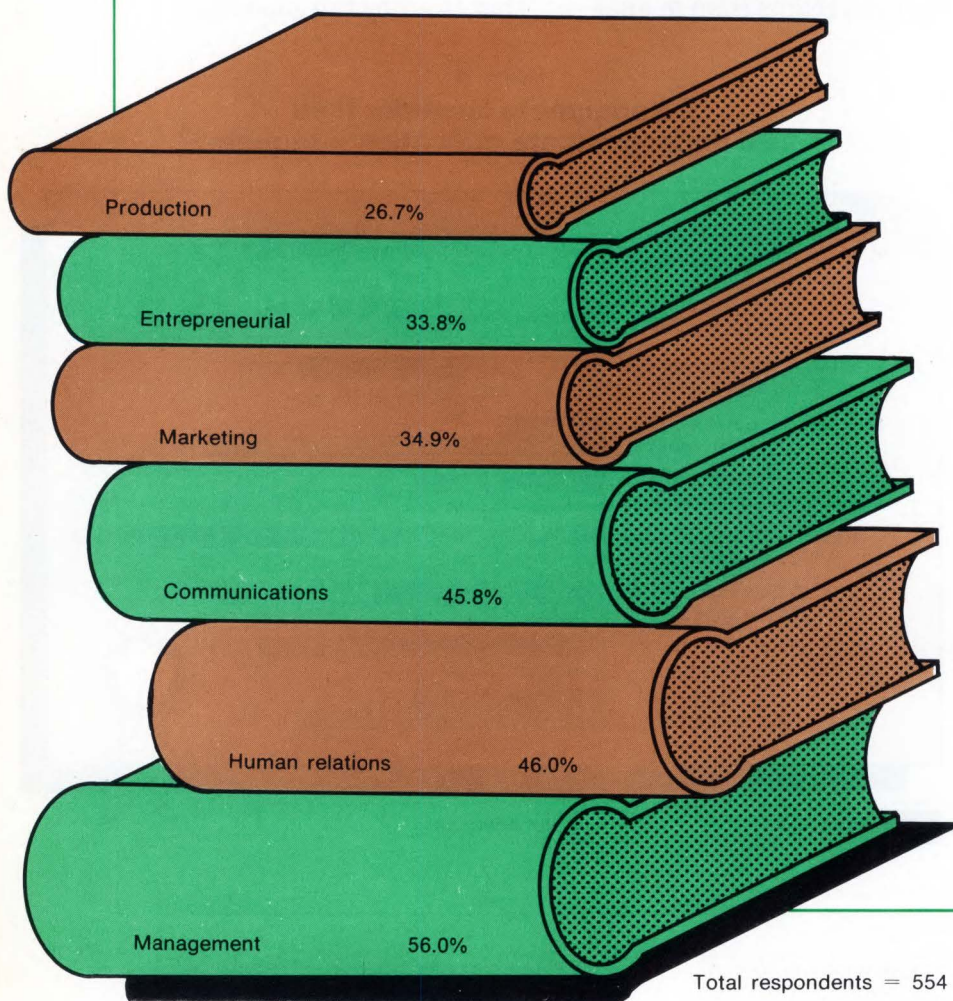
part, abstain from a technocratic view. Rather, they seem ready to shoulder social responsibilities.

"Should technical progress be equated with military programs?" asked one. Another expressed concern over the "dehumanization of human beings in a complex, dynamic society." Others worry about the "general moral decline of business," and a reader admits he does not want to work on military-related projects." Social problems, says one reader, "are not being solved or ameliorated, just institutionalized." But for another the most important issue is to maintain government funding for his project "at least until it's operational."

One engineer asks, "If we continue automation and robotics, what will happen to the people we displace?" Even more pointed, another says that engineering "must broaden its views to include other, not necessarily technical solutions to problems." A third fears what he sees as a growing trend—"absolving individuals of responsibility for their actions." Perhaps the most eloquent summation is this: "Technology is a gift, not a right. The issue is how we, as a nation, use our technology to create better living conditions for all." □

Figure 20

Other courses that might have rounded out EE undergraduate curriculum



Total respondents = 554

Because we're the only company dedicated to CMOS VLSI for genius Signal Processing, we march to the beat of a different drummer.

We're Logic Devices Incorporated.

And the fact that we only produce incredibly intelligent CMOS VLSI for genius *Signal Processing* should be music to your ears.

As such, our products have to be letter perfect. Our technology more advanced. Our prices more competitive. And our thinking light years ahead.

Our multipliers, for example, offer 2 micron capability in 8×8 , 12×12 and 16×16 configurations. They're plug-compatible with existing TRW or AMD bipolar parts, pin for pin.

You can order them in commercial and military temperature ranges, including 883B screening. And, of course, in ceramic or plastic packages.

And you can order them right now. Through us or our distributor, Diplomat.

Take a look at the chart below and you'll see how our low power, high speed multipliers stack up against the competition. (We also feature a 25 ns, 60 mW multiport register file — a necessary component for future Signal Processing systems.)

You'll find our logic devices can be used in a host of applications. From radar processing, sonar processing, guidance systems, imaging and simulators, to just about every possible telecommunications need.

However, to compete successfully in today's redhot Signal Processing market we'll have to offer more. Toward that end, we'll soon be producing an entire family of high-performance CMOS bit-slices and ALU's.

For further information on the only company dedicated to CMOS VLSI for genius Signal Processing and the facts on our family of multipliers, call our Marketing Department at 408/720-8630. Or write, 628 East Evelyn Avenue, Sunnyvale, CA 94086, Telex: 172387.

You'll find that the company who marches to the beat of a different drummer is playing your song.

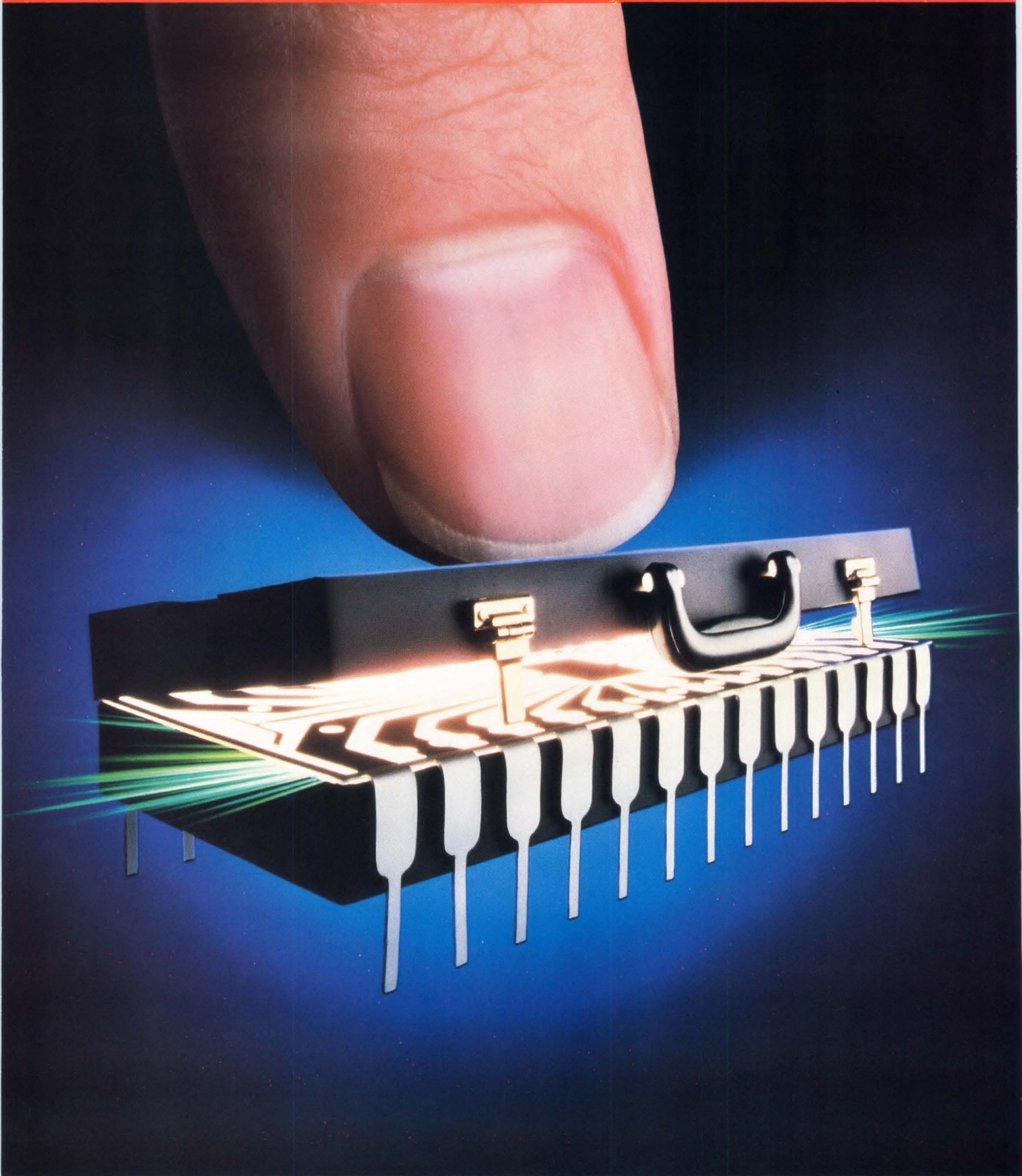
PART NO.	PARALLEL MULTIPLIER	POWER*	TMC/ ACCESS*	BIPOLAR EQUIV.
LMU08	8×8 Bit	60 mW	65 ns	MPY-008H
LMU8U	8×8 Bit Unsigned	60 mW	65 ns	MPY-08HU
LMU12	12×12 Bit	100 mW	80 ns	MPY-012H
LMU13	12×12 Bit Microprog	100 mW	80 ns	—
LMU16	16×16 Bit	125 mW	100 ns	MPY-016H AM 29516
LMU17	16×16 Bit Microprog	125 mW	100 ns	AM 29517
REGISTER FILE				
LRF08	8 Bit Multiport	60 mW	25 ns	—

*Typical



LOGIC
DEVICES INCORPORATED
The Genius in CMOS Design.

**We pack CMOS ROMs so densely
something gets squeezed:**



...the price.

	Part Number	Organization	Access Time (ns)	Operating Current (mA)	Standby Current (μ A)	JEDEC Package	50K Price
	CDM53256 *	32Kx8	250	12	50	28 pin Type B	To be announced
	CDM53128	16Kx8	250	10	50	28 pin Type B	\$3.00
	CDM5364	8Kx8	250	12	50	24 pin	\$2.50
	CDM5365	8Kx8	250	12	50	28 pin Type B	\$2.50

* Available first quarter 1985. Patterns accepted 12/84.

Now, CMOS ROMs at NMOS prices.

RCA has broken the price barrier. For the first time, you can buy CMOS ROMs from RCA for the same price as NMOS ROMs. That's a lower price than any other CMOS ROMs on the market.

Our new space-efficient chip cuts manufacturing cost. Using a new and smaller space-efficient silicon chip, RCA has made CMOS ROMs the same size as most NMOS ROMs—even smaller than many. We shrank geometries down to 3μ and arranged memory cells in a NAND-stack configuration that uses the small space more efficiently. Our costs go down, so your price goes down.

Faster than NMOS, too.

At a maximum access time of 250ns, RCA ROMs are even faster than many NMOS types. Cheaper and faster? Well, you'd expect the breakthrough in CMOS ROMs to come from the inventors of CMOS.

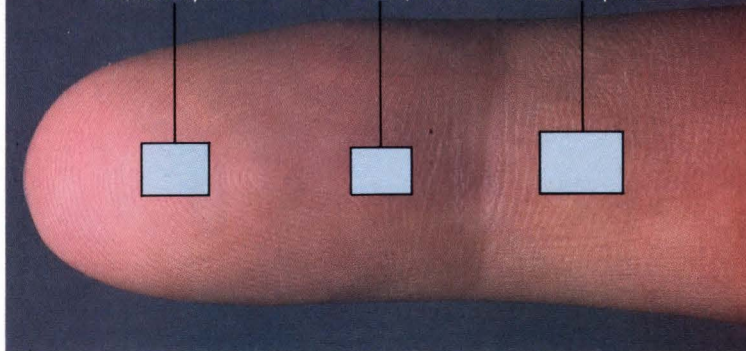
Pin-for-pin compatibility.

RCA ROMs feature the same pinouts as competitive NMOS and CMOS ROMs or PROMs. They are input and output compatible with CMOS or TTL logic. So now it's easy to give your existing design the advantages of CMOS technology...lower power consumption, wider temperature range, etc.

Pack your pattern to your RCA sales office today. Squeeze your ROMs, before your competition squeezes you. To put CMOS advantages in your design, call your local RCA sales office for a price quote today. For technical brochures and ordering information **call toll-free 800-526-2177.**

Comparison of 128K ROMs

Manufacturer T NMOS 30,000 sq mils	RCA CMOS 25,404 sq mils	Manufacturer H CMOS 45,600 sq mils
--	-------------------------------	--



If you would like an RCA salesperson to call on you with detailed information on price, delivery and technical considerations, please send this coupon to: RCA Solid State, Box 2900, Somerville, NJ 08876.

End product application: _____

What size ROM required? _____

Name: _____

Title: _____ Phone: _____

Company: _____

Address: _____

Call: Hamburg, 49-4106-6130; London, 44-03-2785511; Paris, 33-3-946-5656; Hong Kong, 8-52-3-723-6339; Sao Paulo, 55-11-210-4033.

Changing to serve you better.

RCA

SOLVING THE MYSTERY OF THE BLUE SKY PHENOMENON.

This is the 2nd in a series of technical papers from Zilog, designed to give engineers new insights into Zilog microprocessors — what advantages they provide for particular products and why they are the choice among engineers who need optimum performance.



In the microprocessor world, the "Blue Sky Phenomenon" refers to microprocessor development code crashes. The code simply and quite mysteriously disappears. The most common culprits are bugs. And the fact is, simple program bugs will crash most microcomputers.

The hosts for some of these bugs have famous names. What they all have in common is an absence of mechanism to protect against crashes. There is one exception.

The Zilog Z8000® family provides comprehensive hardware protection to help create systems that are resistant to system crashes so common in primitive architectures. The Z8000 CPU is not only more reliable in this sense, but it's easier to learn how to use. Especially if you already know how to use the ubiquitous Z80® CPU.

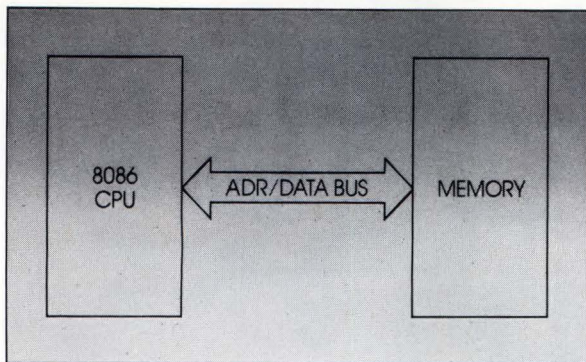
LOST IN THE WILD BLUE YONDER.

There is a technological reason why some microprocessors are so prone to corruption. It stems from the direct connection of the memory to the

processor. Without any checking hardware between the processor and memory, the processor can change any area in its memory at will — without regard to the consequences. Such a lack of restrictions allows illegal operations such as changing program memory stack underflow (running the stack into the data area), and even modifying the code of the operating system. This lack of appropriate technology has two glaring results:

- Illegal operations cannot be detected before damage has occurred.
- Any damage to the program and data cannot be undone.

There are far-reaching implications for a lack of memory protection. Systems designed without it do not support multiple users, nor even UNIX™ very well. The simplest bug will crash the system. There is no protection and no recovery mechanism against even minor problems of access violations. The ability to handle more than one user is usually not allowed, or is strongly discouraged.

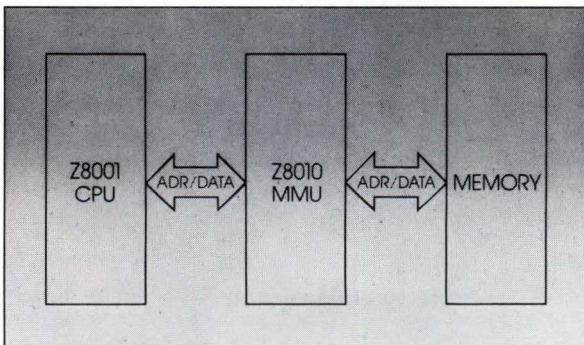


A typical Intel 8086-to-8088 configuration, the lack of memory checking hardware—the memory to the processor. The processor can change any area in its memory at will, without regard to the consequences. The result: illegal operations cannot be detected before damage has occurred; and any damage to the program and data cannot be undone.

THE Z8000 CPU—THE FULL-PROTECTION MICROPROCESSOR.

Zilog's Z8000 CPU solves these problems by inserting a chip called the Z8010 MMU (memory management unit; available in paged or segmented versions) between the processor and memory. This chip normally passes addresses from the processor to the memories—checking each memory access for its address and type of operation as it occurs. If the MMU chip detects an illegal operation, or the use of an unauthorized address, it suppresses the illegal operation and interrupts the program. It passes control to the operating system. Once the program is stopped, the operating system can inspect, correct, or abort the program that caused the error. All with no wait states.

A system constructed with the Zilog MMU can allow many different programs to run without the fear that one program could entirely stop the rest or even corrupt the rest. But, the memory management hardware goes beyond providing protection. It also simplifies system implementation.

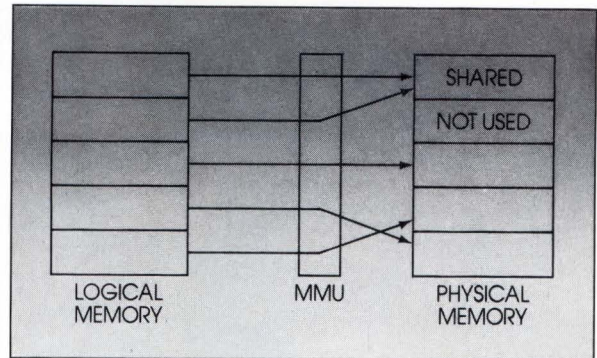


Zilog's configuration system prevents the Blue Sky Phenomenon by inserting a chip called the Z8010 Memory Management unit between the processor and memory.

HIGH LEVEL LANGUAGES REQUIRE MEMORY MANAGEMENT.

One of the strengths of 16-bit microprocessors—and the Z8000 CPU in particular—is that they support high level languages such as C, PASCAL and FORTH. A goal of most users is to allow more than one of these high-level language programs to execute in the processor at the same time (multi-user/multi-tasking)—gaining more effective utilization of the computer. The challenge is to provide an architecture that allows a language compiler to produce code targeted to run at one address, but allows the actual placement at

a different physical address. This mapping is known as logical to physical translation—a feature of the Z8010 MMU.



Zilog satisfies the common requirement for systems to share information with our MMU. The logical-to-physical translation capability allows more than one logical area to access a common physical area.

SHARED MEMORY IN THE Z8000 CPU.

Another common requirement for systems is the need to share information. With Zilog's Z8010 MMU, the logical-to-physical translation capability allows more than one logical area to access a common physical area. When combined with the protection capabilities of the Zilog MMU, you can set up areas that can be common read-only while the same physical area could be read AND write when accessed under different conditions (operating system access).

For example, you could construct a process control system that posts status information into a common area. The central core of the system is allowed to read and write this common area. Application programs that need access to this information can read it through a totally different segment—that is translated into the proper physical address—but with the provision that all access must be reads, not writes. If an application program were to run wild and attempt to corrupt the common area by writing into the read-only space, it would be intercepted before any write could occur.

The key benefit to using Zilog's MMU to implement shared memory is its flexibility to make multiple logical segments access a common physical area with all of the protection—or lack of protection—desired. All with no overhead per access. What's more, Zilog's MMU and other Z8000 devices are available from a host of reliable second sources.

Solving the problem of the "Blue Sky Phenomenon" is only one of the technological hallmarks of the Z8000 CPU. Others will be discussed in this continuing series of technical papers from Zilog, Pioneers of the Microworld. For details on the Z8000 CPU, call our Literature Hot Line at 800-272-6560.* Or write: Zilog, Inc., Technical Publications, 1315 Dell Avenue, MS C2-6, Campbell, CA 95008. *For seminar dates and training information from Zilog, call 408-370-8091.

Unix is a trademark of AT&T Bell Laboratories
Zilog is licensed by AT&T Technologies, Inc.
All Zilog products named are either trademarks or registered trademarks of Zilog, Inc.

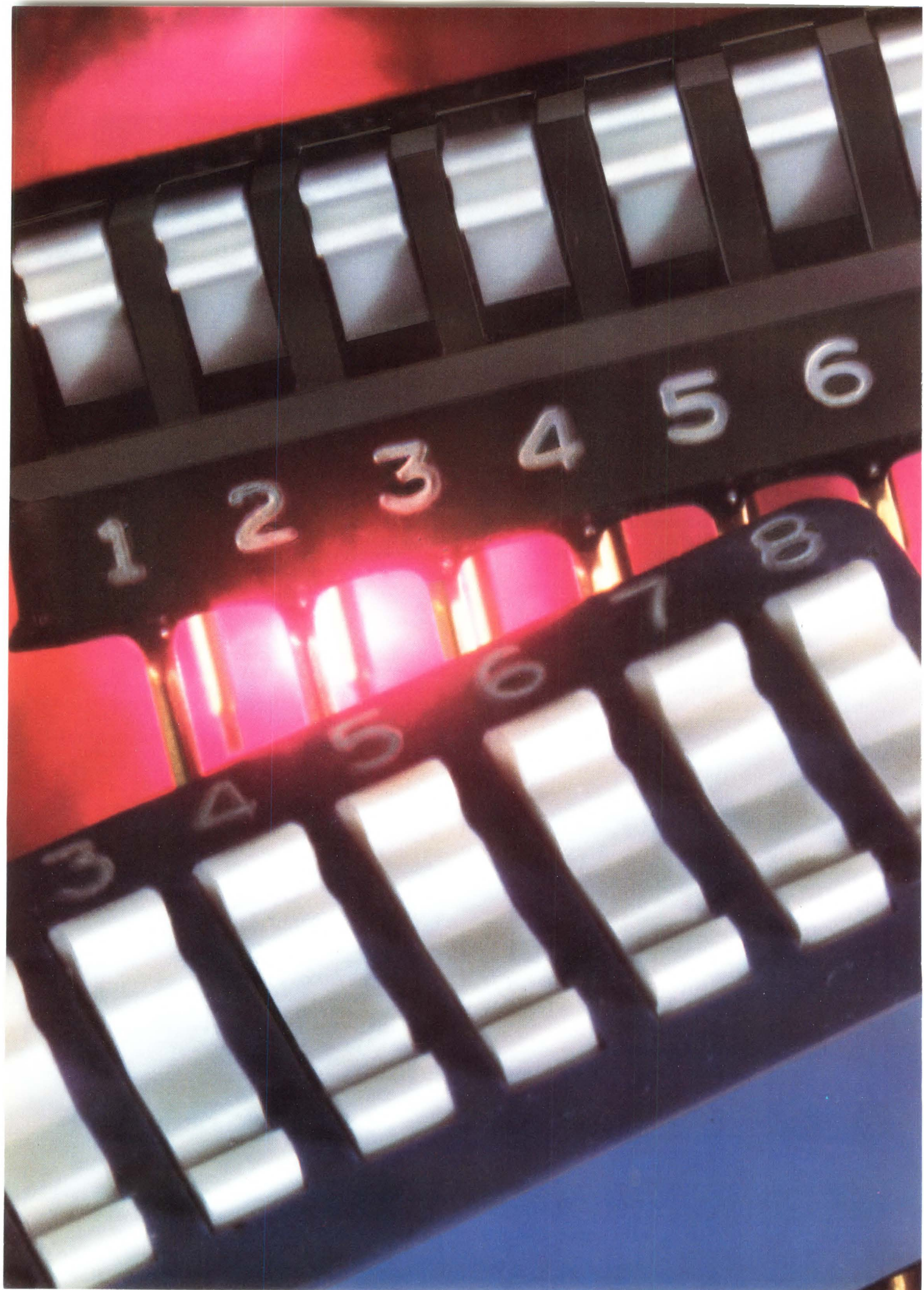
Zilog

Pioneering the Microworld

an affiliate of

EXON Corporation

"See us at Wescon, Booth #3669 and
at Electronica '84, Stand 18, D60, 18."





Everything you demand in DIP switches is now available from the people who invented them.

Total reliability, immediate delivery, competitive prices—you can get all this *and* design superiority from AMP.

Our selectively plated wipe/back wipe contacts give you 30 micro-inches of precise, dependable gold. To eliminate contamination and solder wicking, our switches are all epoxy bottom-sealed and available with tape or plastisol top sealant, as well.

We also make them easy for you to get. Computerized regional delivery guarantees you shipment of all popular styles.

Our prices? Thanks to automation, you'll be impressed. Just ask.

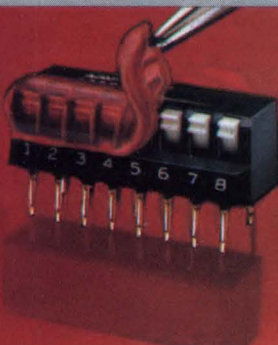
For more information, call the AMP DIP Switch Desk at
(717) 780-4400. AMP Incorporated, Harrisburg, PA 17105

CIRCLE
NUMBER
40

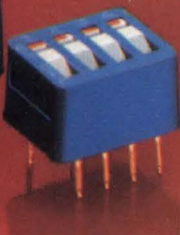
AMP means productivity.



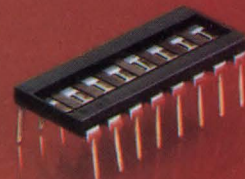
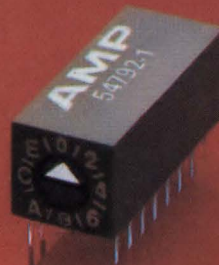
3 x 9 switch offers over
19,000 code combinations.



Plastisol sealing withstands
high pressure aqueous
cleaning techniques.



Hexadecimal and BCDs are
among our style variety.



Low-cost DIP shunts
are AMP exclusives.



Wire-Wrap is a registered trademark of Gardner-Denver
VAX is a registered trademark of Digital Equipment Corporation

Wire-Wrap can't be used with High Speed Logic ... and Bumblebees can't fly!

An aeronautical engineer once "proved" that bumblebees can't fly, because they couldn't possibly move their wings fast enough.
And a lot of people still believe that.

But Bumblebees can fly.

Some electronic engineers believe that Wire-Wrap can't be used with high-speed logic, down to the sub nanosecond range.

But Augat's been doing it for years.

So you can have high-speed logic, plus all the advantages of Wire-Wrap: faster time to market, design flexibility, better thermal management, component pluggability, and the lowest possible development costs. Along with the kind of engineering support you would expect from the market leader.

VAX-BASED WIRING SOFTWARE MAKES IT FLY

The key to making high-speed logic perform in Wire-Wrap is Augat's VAX-based wiring software.

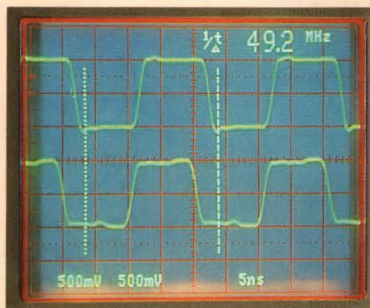
You might expect problems with crosstalk, uncontrolled high impedance, and propagation delays.

But, in fact, crosstalk can be minimized through the selective use of twisted pair wiring, and transmission line reflections can be nearly eliminated by the proper wiring of terminating resistors. Orthogonal wiring is always routed to minimize line length, and even point-to-point wiring is automated.

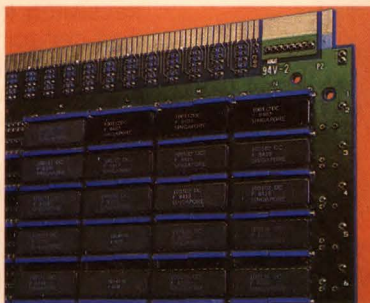
Once the VAX is done routing and analyzing your circuit requirements, a machine-readable set of documentation is provided to you to assist you in debugging the board and back-annotating your CAE database.

WIRE-WRAP BRINGS YOU A BEEHIVE OF BENEFITS

Wire-Wrap offers numerous advantages in developing and producing high-speed logic boards.



This unretouched photo shows a .8 nsec rise time pulse at the entry point (top wave form) and at the end (bottom wave form) of a 21" Wire-Wrap transmission line. By using twisted pair and properly terminating the line, ringing and reflections are minimal.



F100K ECL devices and terminating resistors on a Wire-Wrap panel.

The inherently low capacitance of a Wire-Wrap transmission line increases signal velocity. Circuit changes are easy to make, without incurring sudden, unexpected costs or delays.

Wire-Wrap boards run much cooler than multilayer, because the pins act as radiators. One test showed that the ambient temperature for a large Wire-Wrap board was a full 7 degrees C. cooler than the same circuit in multilayer. That means increased component life and product reliability.

Pluggability makes it easy to replace parts when they fail or upgrade with new components when they become available. Or to work around component scarcity, building boards in advance and plugging in components as they arrive.

Wiring information can easily be extracted from your CAE workstation, so you can transmit the data to one of the Augat wiring facilities and have fully wired and documented panels sent back to you in days, not weeks.

AND THE SWEETEST PART OF ALL — YOU GET TO MARKET FASTER

Augat has all the design and engineering tools in place to support you when you need it the most. And the largest inventory in the industry of standard Schottky, 10K ECL, and F100K panels — all available from a nationwide network of distributors.

So, before you design that next generation high-speed board, you should have Augat's Wire-Wrap Flight Manual.

Because, after all, bumblebees can fly.



Write for the
AUGAT
"Wire-Wrap
Flight
Manual"

AUGAT® **INTERCONNECTION
SYSTEMS**

Quality and Innovation

CIRCLE 77

See us at
WESCON
Booths
2338-2345

40 Perry Avenue, P.O. Box 1037, Attleboro, MA 02703 (617) 222-2202 TWX 710-391-0644

Flexible Solutions to Your Rigid Requirements

When it comes to membranes, Cherry has layers of expertise...to give you unlimited options. Which means your Cherry membrane can have any shape, any key arrangement, color or legend. Encoded or non-encoded. With or without tactile feel, static or RFI shielding.

Any special pattern, surface effect or color combination graphics you specify, Cherry will produce. Screened or extruded textures, embossed keys, gloss or matte finish.

Custom design, a modified standard or an off-the-shelf standard, Cherry has them all. Complete system designs, too. For communications interface, alphanumeric lighted displays or other keyboard-associated subsystems. Working from your schematic...or creating a custom design to your specific task objectives.

All this and unbiased application engineering assistance. Because we're expert in all the most cost-effective keyswitch technologies...membrane, gold crosspoint and capacitive. A good reason to make Cherry your key source for linking man and machine.

Send for your free Cherry Keyboard Kit. Then let us suggest the solution that's right for your application.

*Wireless Keyboards
too! Call me at
1-312-578-3524
Bob Terwall*



CHERRY ELECTRICAL PRODUCTS CORP. 3609 Sunset Avenue, Waukegan, IL 60087 • 312/578-3500

"See us at WESCON/Anaheim, Oct. 30 - Nov. 1,
CHERRY BOOTHS 2454-2458"

MEMBRANES

DATA ACQUISITION

WITH PERSONAL COMPUTERS

AN EDITORIAL SERIES

**PERSONAL
COMPUTERS**

FROM DESIGN
TO MANUFACTURING





**Testing, measuring,
and data acquisition
in general find
a strong ally in the
personal computer.
While it instills smarts
in instrument systems,
it joins forces
with IEEE-488 setups
as a bus controller.**

When personal computer-based instruments first marched into the field, they looked as if they would split the test and measurement world into two opposing camps destined to do battle with each other. In one camp, hardware and software collaborated to form instrument systems that harnessed the power of the personal computer. In the other camp stood the well-entrenched IEEE-488 instrument systems.

The battle never came to pass. Personal instruments began to merge their strong points with those of traditional systems, while the trusty IEEE-488 instruments started welcoming the personal computer into their fold.

Initially personal instruments were easy to spot. A circuit card fitted inside the computer and hooked up with its internal bus; software then turned the combination into a synergetic tester, meter, or instrument system.

Engineers said good-bye to expensive IEEE-488 instruments, with their redundant displays and microprocessors, and good-bye to bench instruments with their confusing manual controls. The personal computer would eliminate those problems, or

so everyone thought.

In reality, the circuit board was usually restricted to one computer and its look-alikes. What's more, the computer's internal bus was an unfriendly electrical atmosphere for processing low-level signals with precision. As a result, hardware flexibility was generally compromised, and performance on a par with traditional instruments could not be expected.

On the bright side, the personal computer's analysis capabilities were exactly what the test and measurement communities needed. Results could be stored, manipulated, and finally displayed in a meaningful format on the CRT.

With that as its strength, the personal instrument pushed into a second generation. In these instruments the hardware of the setup has moved out of its own dedicated enclosure and into a separate chassis, which still interfaces with the computer's internal bus through an umbilical cable.

The hardware is no longer constrained by the space and power-supply limitations of the computer. Nevertheless, the wealth of different personal computers makes it virtually impossible at this stage

to standardize on an internal bus configuration.

Just how the relationship between the personal computer and instruments affects data acquisition comes to light in the following pair of articles. One of the articles represents the next step in the evolution of the personal instrument.

The article portrays a sophisticated data acquisition and analysis system—based on the IBM PC personal computer—that blends the power of the computer with the specialties of the instrument modules. Software takes the computer's analysis skills to new heights, but more notable is the hardware interface between the PC and the instrument—the standard IEEE-488 interface bus, the strength of the traditional instruments.

The second article spotlights the interaction between the user and instrument systems. Here a software package permits the HP150 personal computer to control IEEE-488 instruments with its touch-sensitive screen. In fact, the arrangement represents the first time that a personal computer-based instrument system can be controlled with the touch of a finger.

PERSONAL COMPUTER SERIES



Personal instrument system blends two worlds in testing and measuring

Drawing on the power of an IBM PC personal computer, a modular instrument system builds a strong base for acquiring data at rates topping 200 kbytes/s.

One benefit of today's low-cost computing power is the merging of personal computers and instruments to provide a variety of new solutions in testing and measuring. For example, tasks associated with data collection and analysis, robotics, and CAD/CAM are now routinely performed with desktop computers.

William L. Elder, IQS Inc.
Gerald R. Potts, G.R. Potts Associates Inc.

As president of IQS in Garden Grove, Calif., William L. Elder directs the development of new products. Before joining the company five years ago, he worked with National Semiconductor. He holds a BSEE from the University of California and has long been involved in instrumentation.

Gerald R. Potts is president of G.R. Potts Associates, a consulting firm in Flint, Mich., that specializes in industrial computer instrumentation. He holds a PhD in mechanical engineering from Kansas State University.

Events have moved so quickly that three generations of instrument systems based on the personal computer have already evolved. The first generation interfaced the computers with existing or new dedicated instruments through an IEEE-488 or RS-232-C port.

The next generation took the form of board-level instruments hooked directly onto personal computer buses. Indicative of the emerging third generation, which combines the advantages of dedicated and board-level instruments, is System 416, a high-performance multichannel setup that acquires and analyzes signals and data.

The system's modular design preserves the flexibility of board-level approaches, in which features can be added or deleted as required in building-block fashion. At the same time, the system per-

forms on a par with conventional dedicated instrument systems, but it eliminates their redundant manual controls and displays.

Powerful turnkey software in the host personal computer couples tightly to the hardware and offers a variety of time- and frequency-domain signal processing. What's more, the software sets up a simple user interface with the system's powerful acquisition and analysis features.

A versatile system

The coupling of hardware and software yields a system suited to analysis tasks ranging from the spectral distribution of noise produced by semiconductor devices to filter network evaluation and transmission line monitoring. Other diverse areas satisfied by the system include monitoring multiple channels of electro-physiological data, analyzing industrial vibra-

tion, and analyzing the acoustical signatures of rotating machinery. The system's modal analysis gives an animated breakdown of vibrating systems.

Based on the IBM PC personal computer, the instrument system simultaneously captures 4 to 16 channels of waveform data (nonmultiplexed) with a maximum throughput in excess of 200,000 samples/s per channel. Moreover, all channels have fully independent and software-programmable amplifiers, antialiasing filters, and sampling rates.

For applications in which multiplexing is permissible, the system can be expanded to 4096 channels. In addition the hardware sports such features as signal conditioners, digital I/O waveform generators, input triggers, and sampling synchronizers.

Flexible signal acquisition

A look at the system in detail shows that the programmable-gain amplifier module consists of up to 16 wideband amplifiers, each having a balanced input and a gain selectable from 1 to 100. Covering a bandwidth of dc to 100 kHz, the amplifiers are fully overload protected and can either be used as direct inputs or be connected to the outputs of other signal-conditioning

modules.

Antialiasing filters, which are missing from most data acquisition systems, ensure that frequency components exceeding the Nyquist frequency (half the sampling rate) do not cause errors in the acquired data. Because signal sources may have an arbitrary spectral content, such filters are essential for signal analysis.

This filtering is accomplished with steep analog filters that feature logarithmic frequency tuning in 4096 discrete steps, from 1 Hz to 70 kHz. The system's dynamic range is not diminished by the filters, and high-resolution tuning makes for relatively smooth corner-frequency control when spectral shifts are tracked. Such shifts include those associated with the spin-up or spin-down actions of rotating machinery.

Each analog output module supplies four channels of 12-bit dc or ac signals, with conversion rates in excess of 1 MHz. The output channel and dc output level are programmable through the system's communication port.

By selecting a special DMA mode that feeds continuous updates from prestored waveform tables in RAM, the user obtains the functions of an arbitrary waveform generator. Moreover, the IBM machine's

disk drives can be used to store arbitrary waveform tables that are uploaded or downloaded from the system.

A digital I/O module provides 16 protected inputs that can be equipped with fuses and 16 outputs that tie directly into external devices or optoisolation boards. Furthermore, the module's single-chip, 32-bit programmable I/O device ensures maximum space reduction and versatility.

Direct memory access

A 68000 CPU tightly controls the instrument modules. Also, since direct memory accessing is used for analog acquisition, the CPU is not burdened with unproductive overhead.

Communication between the system and the computer takes place through the IEEE-488 interface bus, permitting clusters of multiple instruments to transfer data at high rates. (The RS-232-C interface will be added later.) Although the IEEE-488 interface module in the system supports DMA transfer rates up to 1 Mbyte/s, the corresponding interface module in the personal computer has a 300-kbyte/s data rate. The latter rate is more than adequate for most applications, because the system software grabs information from the

PERSONAL COMPUTER SERIES



data buffers when needed, much like a file server, thereby speeding the effective data access time. Because the system has several mega-

bytes of RAM, data storage does not rely entirely on the personal computer's memory.

An important element of the system is its open-hard-

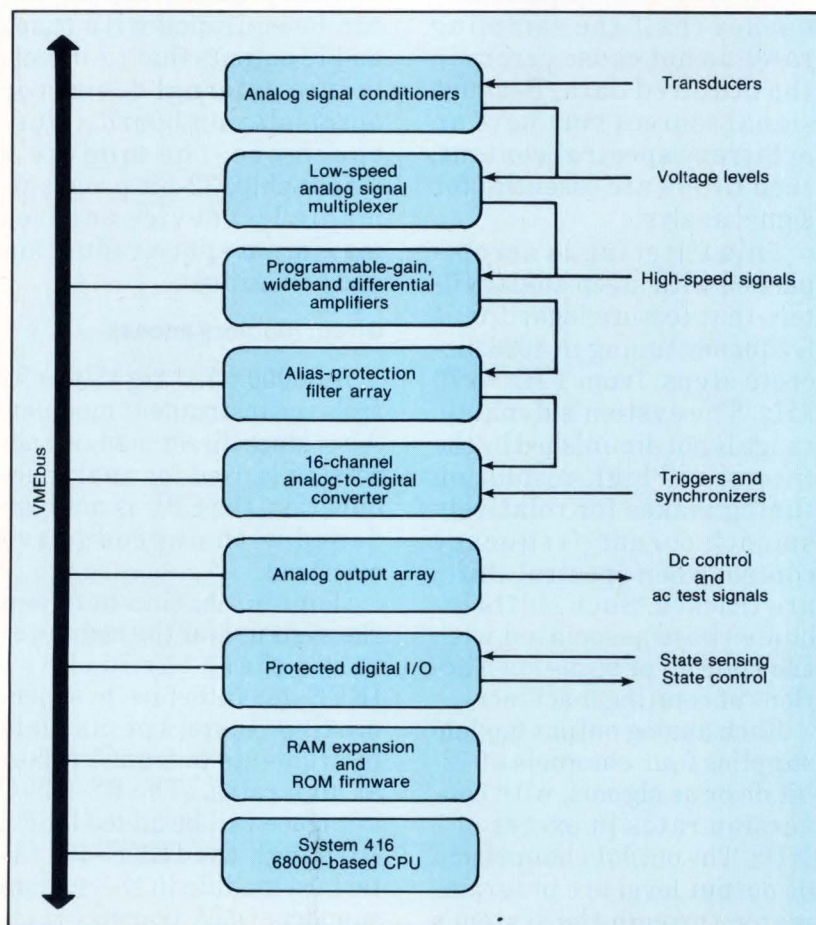
ware architecture, which is based on the standard VMEbus (Fig. 1). Besides supplying power to the various modules, the bus establishes a high-speed path for transporting data and control signals to and from the modules.

Further, the bus's electrical characteristics and 32-bit width permit the use of powerful microprocessors and modules that require high data rates. The bus, which fits the Eurocard format, also has the electromechanical reliability necessary for instrument applications.

Software vs. hardware

In a typical test and measurement system, software takes a back seat to the hardware. In reality, though, software is of equal, if not greater, importance to the system user. In particular, users of systems built around the personal computer are not inclined to commit large resources to developing custom software.

Many instrument systems have addressed that problem with specialized data acquisition languages and extensions to Basic and Fortran. Despite that, a relatively heavy programming burden may still fall on the user. The System 416 uses Pascal, a structured programming lan-



1. Boasting an open-hardware architecture, the personal computer-based System 416 is based on the VMEbus and can be configured in modules for a wide range of purposes. The high-performance bus creates an efficient highway for transporting data and control signals to and from the modules at high speed.



For additional information, clip and mail to:
Plessey Microsystems, One Blue Hill Plaza,
Pearl River, NY 10965.

PERSONAL COMPUTER SERIES



guage with a reasonably broad base of familiarity.

When compiled, the language affords good execution speed for user application programs. In order to obtain maximum speed, digital signal processing and graphics tasks are handled in machine code.

Because the functions are in relocatable object form, they can be easily linked to programs developed in Pascal or other high-level languages. For the system's internal software, the C language brings the necessary efficiency and support to VME-bus systems.

Among the signal-processing aids is a floating-point implementation of the fast Fourier transform (FFT), which serves as the basis for a number of frequency-domain functions. Furthermore, time-domain processing and complex arithmetic operators expand the analysis capabilities to include such things as an inverse FFT, cross-correlation, integration, differentiation, and period extraction. For optimum speed, most signal-processing functions take advantage of the 8087 math coprocessor.

A choice of displays

Graphical display routines plot output data in line, bar, and evolution (waterfall and

mountain range) formats. Furthermore the computer's display can plot multiple spectral, waveform, phase, and other presentations.

For example, simultaneous presentations of waveform, frequency, and phase information for four channels is easily accommodated on the computer's display (Fig. 2a). In another type of presentation, amplitude and time cursors obtain precise measurement data at any point on a waveform (Fig. 2b).

Ready to run software

Moreover, general-purpose turnkey signal-processing programs are supplied, and they satisfy a broad range of applications. These programs in effect make up a framework from which users can develop custom programs. The frameworks automatically give a user 60% to 90% of the code needed for a typical application.

Software within the system resides in ROM and was developed in C, a language easily tailored to different applications. Hardware configuration information is stored in the personal computer and is downloaded to the system during initialization.

Most changes in hardware structure can be handled with a menu-driven configuration program; the system firm-

ware need not be changed in these instances. Major hardware changes, which would include the use and control of other vendor's VME modules, are accomplished through optional software development tools. In this way, fully customized test and measurement systems can take advantage of the system's open architecture.

A test and measurement application involving a set of active low-pass filters illustrates the power, flexibility, and simplified programming of the system (Fig. 3). As its objectives, the test measures the transfer function, noise, dc output, and power-supply data and plots the results over a range of temperatures. Ultimately, the system will be controlling the environmental chamber temperature in which the filters are placed.

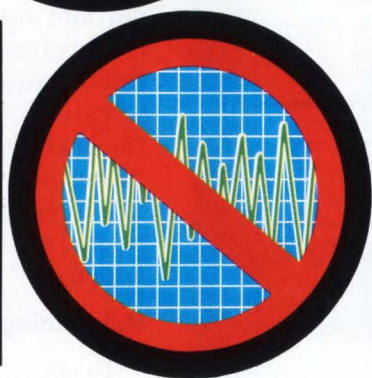
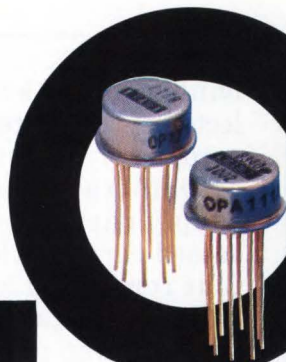
Hardware flexibility

Performing the test requires little additional hardware. Furthermore, the software that handles the control, as well as the data analysis and reduction tasks, is straightforward.

With the hardware tools, 12 of the 16 high-speed analog input channels sample the six filters simultaneously. Moreover, additional clusters of six filters could be measured sequentially with an external

the best FET and Bipolar

LOW NOISE



amplifiers you can buy.

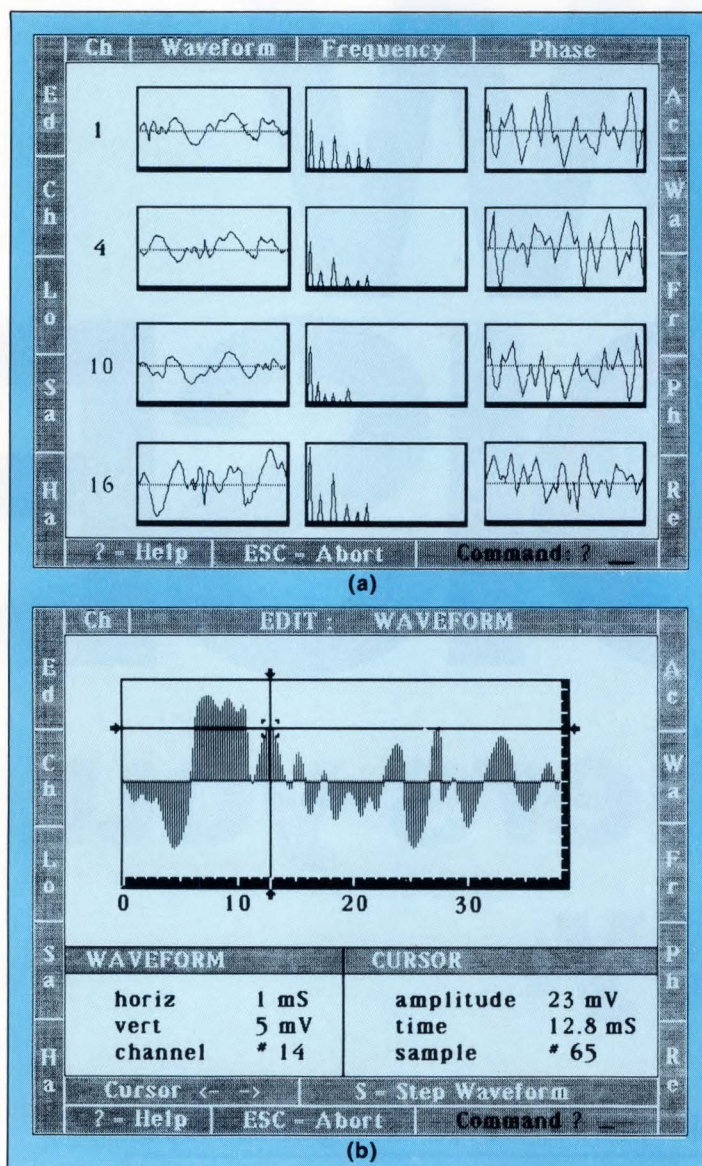
All parameters, including noise, 100% tested and guaranteed.

MODEL	NOISE (10kHz, max)	V _{OS} (max)	DRIFT (max)	I _B (max)
OPA111BM	8nV/ $\sqrt{\text{Hz}}$	$\pm 250\mu\text{V}$	$\pm 1\mu\text{V}/^\circ\text{C}$	$\pm 1\text{pA}$
OPA27AJ	3.8nV/ $\sqrt{\text{Hz}}$	$\pm 25\mu\text{V}$	$\pm 0.6\mu\text{V}/^\circ\text{C}$	$\pm 40\text{nA}$



Putting Technology To Work For You

PERSONAL COMPUTER SERIES



2. Through specific graphics routines, the personal computer's display can present analysis data in a variety of formats, such as multichannel waveform, frequency, and phase presentations (a). The waveform parameters can be directly read out using amplitude and time cursors (b).

bank of signal switches selected by the system's digital outputs.

Temperature and power supply parameters are assessed through three of the four remaining high-speed channels. Because the temperature and power-supply voltage signals change relatively slowly over time, they can be sampled at a much lower rate than the one used for the transfer function. And if more slow sampling channels are needed, multiplexer expansion modules can be added.

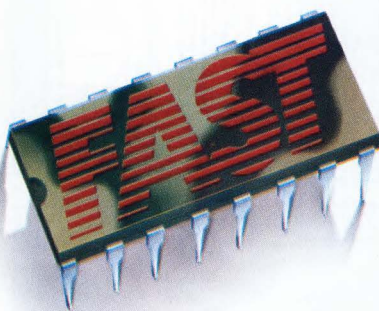
Maintaining temperature

To control the environmental chamber temperature, the heating and cooling mechanisms are switched on or off through two of the system's digital outputs. These outputs are connected to a pair of optically isolated electronic relays (some chambers have built-in TTL-compatible heating and cooling inputs).

Temperature can be gauged by a variety of sensors, including thermocouple and IC types. Thermocouples, which have a nonlinear temperature/voltage characteristic, are conveniently linearized in software.

Software in the host personal computer controls testing by instructing the system, supplying the user interface,

CLASSIFIED 1-A.



Announcing 52 of the toughest devices that ever served their country. The FAST™ high-reliability parts. From Fairchild Digital.

All 52 devices are designed to perform under rigorous military requirements. With 13 currently approved to M-38510 QPL I. And an additional 10 approved to QPL II.

Fairchild high-reliability devices utilize hermetic ceramic packaging and are tested to -55 to $+125^{\circ}\text{C}$ temperature specifications. Plus, our proven FAST (Fairchild Advanced Schottky TTL) technology gives you the best of both worlds. Optimum speed-power performance.

The high-reliability devices from Fairchild Digital. For service above and beyond.

FAST™

From Portland, ME.

FAIRCHILD

A Schlumberger Company

For information, contact your nearest sales office or authorized distributor.

CHECK OUR REFERENCES.

Write for our free Reference Guide featuring **all** Fairchild Digital Hi-Rel devices, including FAST.

Name _____ Title _____

Company _____

Address _____

City _____ State _____ Zip _____

Fairchild Digital Division, 333 Western Avenue, South Portland, Maine 04106.
FAST (Fairchild Advanced Schottky TTL) is a trademark of Fairchild Camera and Instrument Corporation.

PERSONAL COMPUTER SERIES



and presenting the test results in graphical form. In the process, it controls the chamber temperature and acquires and processes the raw data.

To begin programming the test, the engineer first constructs a simple flow chart that he or she then translates into a test program outline—

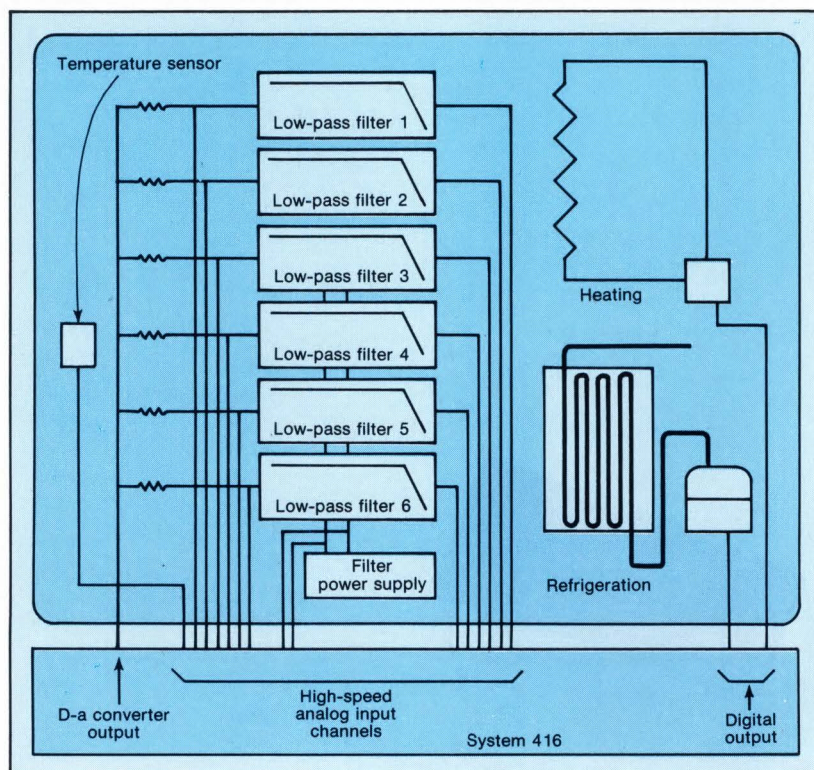
a process simplified by the structured nature of Pascal (Fig. 4). Finally, the program outline is translated into actual source code (Fig. 5). The procedure TEST_TRANS acquires the filter data and computes the transfer function using the FFT and complex division. The five calls used by the procedure illustrate how the system's software development library reduces the amount of user-generated code.

A closer look at the hardware aspects of the tests reveals that each filter requires a test signal and a pair of high-speed analog channels—sampling in parallel—at its input and output. To produce a suitable test signal, a digital-to-analog conversion channel employs direct memory access and uses a look-up table in memory.

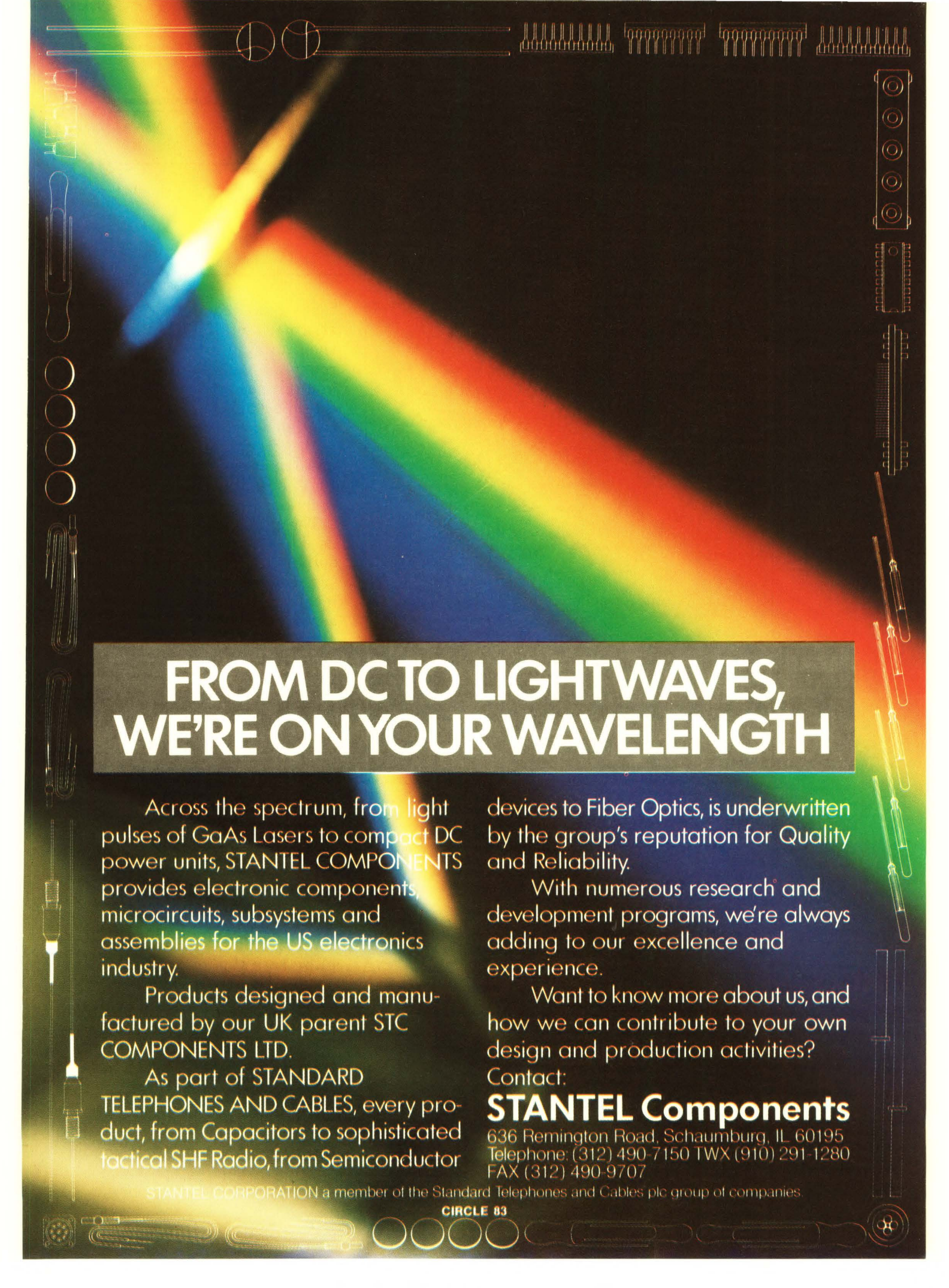
Accent on accuracy

Simultaneous sampling of the filter's input and output prevents time distortion, which would introduce big errors in phase when the transfer function is computed. Measuring the input and output to compute the transfer function means that the spectrum of the test signal need not be precisely controlled.

Moreover, since antialiasing filters are built into the system, the bandwidth of the



3. In a laboratory environment, the instrument system can vary the temperature of an environmental test chamber while it measures the transfer function, noise, dc output, and power-supply stability of a group of six active low-pass filters.



FROM DC TO LIGHTWAVES, WE'RE ON YOUR WAVELENGTH

Across the spectrum, from light pulses of GaAs Lasers to compact DC power units, STANTEL COMPONENTS provides electronic components, microcircuits, subsystems and assemblies for the US electronics industry.

Products designed and manufactured by our UK parent STC COMPONENTS LTD.

As part of STANDARD TELEPHONES AND CABLES, every product, from Capacitors to sophisticated tactical SHF Radio, from Semiconductor

devices to Fiber Optics, is underwritten by the group's reputation for Quality and Reliability.

With numerous research and development programs, we're always adding to our excellence and experience.

Want to know more about us, and how we can contribute to your own design and production activities?

Contact:

STANTEL Components

636 Remington Road, Schaumburg, IL 60195
Telephone: (312) 490-7150 TWX (910) 291-1280
FAX (312) 490-9707

STANTEL CORPORATION a member of the Standard Telephones and Cables plc group of companies.

CIRCLE 83

PERSONAL COMPUTER SERIES



Start of main program:

Initialize system 416

Begin task

Configure 416 (use hardware table);
Preset analog input channels;
Preset filters;
Preset analog output channels;

End of task;

For 3 temperatures, set to -50° , $+15^{\circ}$ and $+80^{\circ}\text{C}$ and do:

Set chamber temperature

Begin task

For each of six filters do the following:

Begin Task

Obtain transfer function (save in array for each filter);
Obtain spectral corrected RMS noise level (save for each filter);
Obtain dc level of filter output (save for each filter);

End of task;

Obtain positive rail voltage (save for each temperature);
Obtain negative rail voltage (save for each temperature);

End of task;

Plot analysis data

Begin task

For each of six filters do:

Begin task

Plot transfer function border graphics and title;
For each of 3 temperatures do:

Begin task

Plot magnitude and frequency response;
Plot phase and frequency response;

End of task;

Plot noise graphic and title;
Plot noise level over temperature (of selected filter);
Plot dc output graphic and title;
Plot dc level over temperature (of selected filter);

End of task (for six filters);

Plot positive power-supply graphic and title;

For each of 3 temperatures do:

Begin task

Plot to new dc level from previous level;

End of task;

Plot negative power-supply graphic and title;

For each of 3 temperatures do:

Begin task

Plot to new dc level from previous level;

End of task;

End of task (plotting);

End of program.

4. Thanks to the structured nature of Pascal, the filter test can be programmed by first developing a program outline.

test signal need not be constrained to fall within half the sampling rate. For that reason, an easily produced pseudo random noise sequence suffices as an excitation waveform for the filters. After taking the input and output measurements, an FFT computes the transfer function.

The analog input channels used in examining the input-output relationship also measure the filter's noise and dc levels. To measure low-level ac waveforms and dc voltages at the filter input and output, the program sets the test signal to zero and increases the gain of the analog inputs. Measurements must be made at the filter input to determine any residual noise and dc offset contributed by the test signal source.

Sampling fast enough

Measured ac waveforms are limited in bandwidth by the programmed frequency of the antialiasing filters, which can range from 10 Hz to over 50 kHz. However, the sampling rate should normally exceed this frequency by a factor of roughly 2.5 or more to avoid potential aliasing problems.

Once the input and output signals are acquired, their dc and ac characteristics are obtained through digital signal

Gould AMI...Innovation and Quality in Semiconductors

A world of choices in single-chip codecs.



Gould AMI Creates World Class Codec Family.

Gould AMI is now producing the industry standard HD44230® series of single-chip codecs. They're a perfect compliment to the proven performance of our own S3506/S3507 codec family. World class features such as . . .

- ATT D3 and CCITT Compatible
- Synchronous/Asynchronous
- Super Stable Voltage Reference
- A/B Signaling
- Ultra Low Noise
- μ /Law, A/Law
- Bandlimiting Filters
- Interface Op Amp

For details, call (408) 554-2311. Because if the job is efficient codecs, Gould AMI is right for the job.

HD44230 is a registered trademark of Hitachi Ltd.

I'm interested in your World Class Codec Family.

- ☐ Send me complete details.
☐ Have a field engineer contact me.

Name _____

Title _____

Company _____

M/S _____

Address _____

City/State/Zip _____

() _____

Phone No. _____

Mail to: Gould AMI Semiconductors
Telecom Marketing
3800 Homestead Road
Santa Clara, CA 95051

ED 10/31



GOULD

AMI Semiconductors

PERSONAL COMPUTER SERIES



```

| Title block |
| . |
| . |
| Variable declarations |
| . |
| . |
| Declarations of procedures and functions which are called by |
| this program but are located externally in libraries |
| . |
| . |
| Procedure TEST_TRANS(var FILT,T:int); |
| BEGIN |
|   get_buffer(1,0,256,1,buff1); | Obtain 256 bytes from 416 channel 1 |
|   get_buffer(2,0,256,1,buff2); | Obtain 256 bytes from 416 channel 2 |
|   fft(256,re1,im1); | Compute input spectrum |
|   fft(256,re2,im2); | Compute output spectrum |
|   div_cmplx(256,re1,im1,re2,im2,im2); | Compute transfer func |
| END; |
| . |
| . |
| Other necessary procedure calls |
| . |
| . |
| Start of Main Program |
| BEGIN |
|   | Initialize System 416 |
|   CONFIG_416(CTABLE416); |
|   PRESET_AN_IN; |
|   PRESET_FILTERS; |
|   PRESET_AN_OUT; |
|   | Test filter system at -50°, +15° and +80°C respectively |
|   TEMP := -50.0; | Starting temperature |
|   DELTA_TEMP := 65.0; | Temperature Increment |
|   FOR T := 1 TO 3 DO | Start of temperature testing loop |
|   BEGIN |
|     SET_TEMP(TEMP); | Set and stabilize temperature |
|     FOR FILTER := 1 TO 6 DO | Filter testing loop |
|     BEGIN |
|       TEST_TRANS(FILT,T); | Test and assign result to proper array |
|       TEST_NOISE(FILT,T); |
|       TEST_DC(FILT,T); |
|     END; | End of filter loop |
|     TEST_POS_RAIL(T); | Measure and record positive supply |
|     TEST_NEG_RAIL(T); | Measure and record negative supply |
|     TEMP := TEMP + DELTA_TEMP; |
|   END; | End of temperature loop |
|   | All tests are now complete and data is ready for display |
|   | Plot Analysis Data |
|   FOR FILT := 1 TO 6 DO | Plot filter data |
|   BEGIN |
|     PREP_TRANS_GRAPH(FILT); |
|     FOR T := 1 TO 3 DO |
|     BEGIN |
|       PLOT_MAGNITUDE(FILT,T); |
|       PLOT_PHASE (FILT,T); |
|     END; |
|     PREP_NOISE_GRAPH(FILT); |
|     PLOT_NOISE(FILT); |
|     PREP_DC_GRAPH(FILT); |
|     PLOT_DC(FILT); |
|   END; | End of plotting filter data |
|   PLOT_POS_RAIL; | Plot positive rail curve |
|   PLOT_NEG_RAIL; | Plot negative rail curve |
| END.

```

processing. Time-domain routines extract the average dc level, as well as the peak-to-peak, rms, and average ac levels. Because ac signals are acquired and processed digitally, their crest factor is limited only by the selected input bandwidth and the analog-to-digital converter's resolution and dynamic range.

Digitally processing the waveforms means that the spectrum of the acquired noise can be easily obtained through the FFT. Subtracting the input spectrum from the output spectrum over a specific range of frequencies gives a better measurement of the noise produced by the filter than simple comparison of rms values. Moreover, the inverse FFT can be performed on this difference spectrum, yielding a noise waveform that is corrected for any unwanted signal at the filter input and is now free for additional time-domain processing. □

5. A program outline is used to generate the source code for the filter test. Calls to the system's machine-language control and analysis routines simplify the task of writing the source code. In the procedure TEST_TRANS, five program statements acquire the filter input and output data and compute the transfer function through an FFT operation.

Custom and Semicustom From Planning to Production

In the competitive world of electronics, cost-effective solutions are crucial. The need to reduce costs by reducing PCB size and component count, with increased reliability has led many to the custom IC market. Having decided on proprietary circuitry, you need expert assistance to do the job quickly and efficiently. Linear Technology Inc. can provide that assistance.

YOU DESIGN OR WE DESIGN

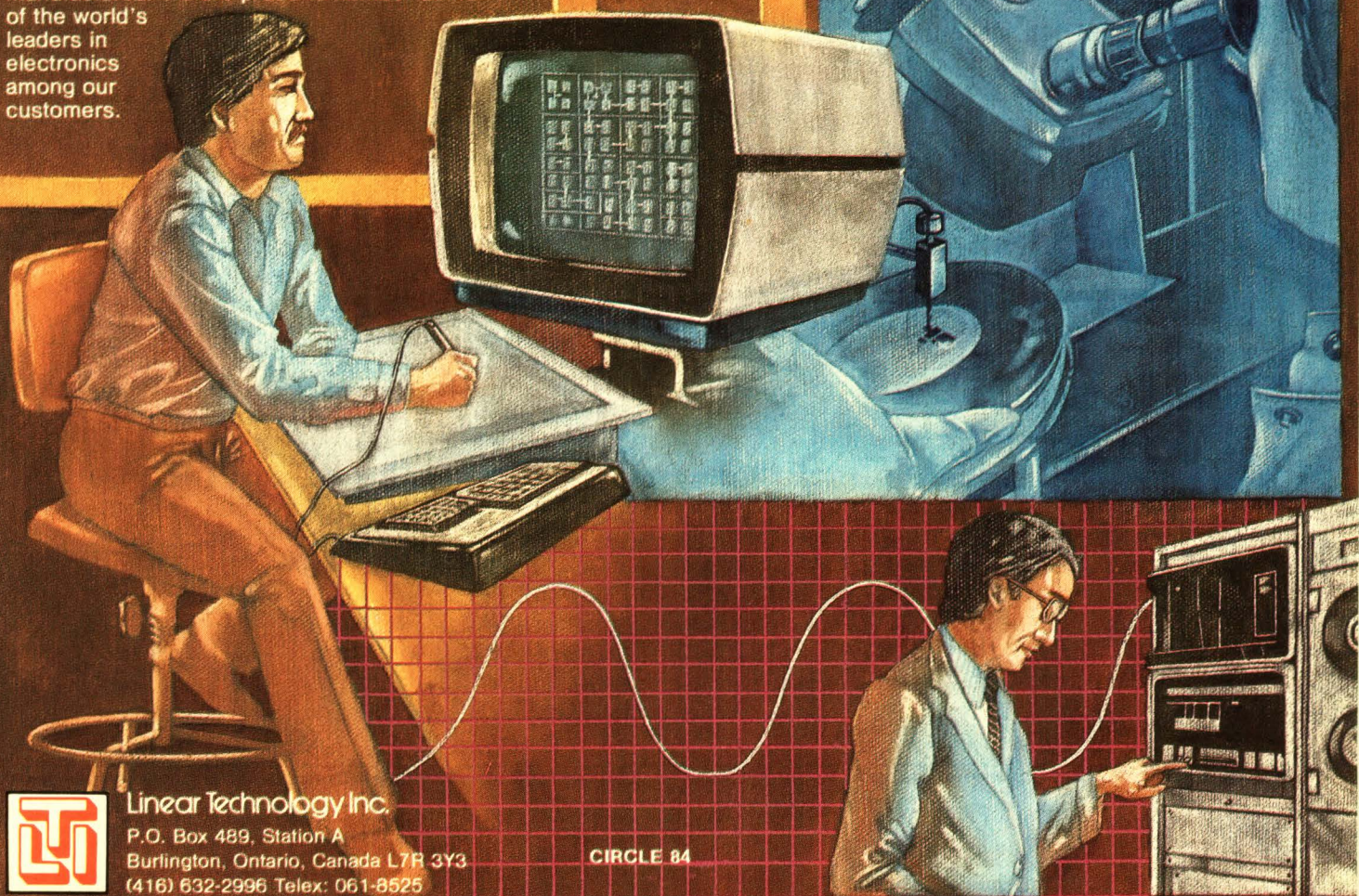
Design your own circuit function with the aid of our design tools or use LTI's team of skilled engineers — with the latest CAD techniques at their disposal to design a custom or semicustom circuit for you.

TOTAL IN-HOUSE FACILITIES

Whether on one of our semicustom chips or in full custom, we can produce a circuit to suit your needs, be it analog or analog/digital. Our fully integrated manufacturing facility allows us to follow through on the *total job*, from design and masking to prototyping, testing and production.

INTERNATIONAL REPUTATION

A pioneer in linear bipolar IC design, LTI products are sold in almost every country where electronic systems and subsystems are manufactured. We are proud to number some of the world's leaders in electronics among our customers.



Linear Technology Inc.

P.O. Box 489, Station A
Burlington, Ontario, Canada L7R 3Y3
(416) 632-2996 Telex: 061-8525

CIRCLE 84

There is a representative near you. Call us or send for our free brochure.

Wayne Felt

PERSONAL COMPUTER SERIES



Software package lets PC control instruments with a touch

A library of assembly-language routines, invoked from high-level languages, turns the HP 150 personal computer into a touch-sensitive IEEE-488 controller.

As personal computers continue to come of age, they are increasingly called upon to demonstrate their maturity—assuming tasks once reserved for desktop machines, minicomputers, and data acquisition systems. Instrument control is a case in point. Wedding an IEEE-488 interface to a high-level PC, for instance, lets it handle instrument communications. Adding standard software to the machine turns it into a data processor par excellence.

One software package, the HP-IB enhancement library (HPEL), transforms the Hewlett-Packard HP 150 into

the only 488 instrument controller to boast a touch screen and to run common MS-DOS data-processing software. A touch screen is a natural for instrument control. Among its numerous virtues, it cuts down on errors by presenting limited-choice menus and also speeds operator interaction. In addition, it lowers the operator's requisite level of mastery.

The HP 150's firmware accesses its disk drives through the machine's built-in IEEE-488 interface. But the software drivers needed by the interface to communicate with other instruments are not supplied. Until now, that has meant the computer's touch screen cannot be put to work in instrument control.

The package, which is furnished on a 3½-in. floppy disk, contains the needed drivers, a sample Basic program that can be run with the Basic interpreter or compiled and ex-

ecuted, and a touch-screen instrument-control program. The drivers are a library of assembly-language routines that can be invoked from all of the common languages that the 150 runs, including interpreted and compiled Basic, Pascal, and Fortran. Each routine implements a particular IEEE-488 command (Table 1).

When called from a compiled Basic program, the library routines execute over 200 bus control commands every second. A typical interpretive Basic program, on the other hand, can forward over 100 calls each second to the library.

Although many IEEE-488 interfaces intended for personal computers boast DMA transfer rates of hundreds of thousands of bytes a second, they involve an unreasonable trade-off in error detection, time-out recovery, and end-of-transmission (EOT) detec-

Douglas R. Haroldsen
Optimatic Solutions Inc.

Before joining Optimatic Solutions in Canoga Park, Calif., Douglas R. Haroldsen worked as a software development engineer at Eaton Corp. He studied computer science at the University of California at Los Angeles.

tion. The library's 20-kbyte/s transmission rate, though, is fast enough that the limiting factor in carrying out communications usually is the speed of the instrument connected to the 150.

Easy on the user

Consequently, ease of use and simplicity of software development—rather than blinding speed—were the prime considerations in creating the library. A call to it consists of a command followed by a parameter list enclosed in parentheses (Table 2), and each call returns one of 69 possible status numbers. These returns are numerically grouped into three categories: nonfatal, format or syntax, and bus time-outs (Table 3).

Nonfatal returns identify inconsistencies between the length of the expected and received data and the end-of-line (EOL) sequences. The second category indicates errors in program syntax. The third specifically points out bus time-outs with respect to the library routine and bus command that encountered the problem. To further aid the programmer, the user's manual lists possible causes of and corrective actions for each return status.

A simple Basic program illustrates how library

calls communicate with IEEE-488 instruments (Program 1). It takes a reading from a multimeter and sends the result, along with the time, to a printer. Specifically, lines 130 through 150 set up the three variables needed to enter data from the multimeter. **MULTIMETER%** identifies the instrument as device 23 on interface 7, the IEEE-488 bus; **FORMAT\$** specifies that the data from the multimeter will be interpreted as ASCII characters; **VOLT\$** is

the string that will receive the voltage reading. Since this particular multimeter puts out as many as 15 characters for each measurement, **VOLT\$** is set to accommodate up to 20 characters.

Line 190 is the call to the library's **IOENTER** routine. The three variables are passed to it along with two others—**RET**, **LENGTH%** and **RET.STATUS%**. The first returns the number of characters sent by the multimeter and placed in **VOLT\$**. The

Table 1. A catalog of the library's commands

Command	Description
IOCLEAR	Sends device clear
IOCONTROL	Direct write to the HP 150's internal HP-IB interface registers
IOENTER	Enters formatted string, byte, or word from the selected device
IOEOL	Sets the end-of-line sequence which may include the sequence for the selected device. Each device may have its own end-of-line sequence
IOIFC	Asserts the HP-IB Interface Clear line for 200 μ s
IOLLOCK	Disables the return-to-local pushbutton on the selected device
IOLOCAL	Commands the specified device or devices to enter the local mode
IOOUTPUT	Transmits formatted string, byte, or word to the specified device or devices
IORESET	Resets the HP 150's internal HP-IB interface
IOSEND	Transmits user-defined commands, secondary addresses, or data sequences
IOS POLL	Enters the status byte from the selected device
IOSTATUS	Directly reads the HP 150's internal HP-IB interface registers
IOTIMEOUT	Sets the time-out value, in milliseconds, for the selected device; each device may have its own time-out value
IOTRIGGER	Sends the trigger command to a selected device or sends a Group Execute Trigger to all active listeners
IOWAIT	Supplies a program wait, specified in milliseconds

PERSONAL COMPUTER SERIES



other returns a number that indicates the status of IOENTER.

At this point, line 230 checks the value of RET.STATUS% to see if the IOENTER call was successful. If a positive value is returned, the call was successful and the program continues. Otherwise, the message enclosed in quotations in line 270 is printed, along with the value

of RET.STATUS%. The program then stops running.

Lines 320 through 340 establish the variables required to transmit data to the printer, which is specified as device 01. The final line in that group employs the character count contained in RET.LENGTH% to strip away the extra spaces in VOLTS\$ leaving just the characters entered from the multimeter. It also appends the

current time (TIME\$) to VOLTS\$.

At line 380, the IOOUTPUT routine is invoked, sending the multimeter reading and the time to the printer. Then, the status of IOOUTPUT is checked at line 420. If that is successful, the program loops back to the top. If there is a problem, the program jumps to line 460, where it displays the value of RET.STATUS%,

Table 2. Understanding the library call syntax for MS-Basic

Command calls syntax	Parameter	Definition
IOCLEAR (SELECT%, RET.STATUS%)	ACTION%	The action performed by IOCONFIGURE 0 equals initialize the HPEL
IOCONFIGURE (ACTION%, INFO%, RET.STATUS%)	DAT.CMD%	0 to send data, 1 to send commands
IOCONTROL (INT.SEL%, REG.NO%, REG.VAL%, RET.STATUS%)	DEV.SELECT%	A combination of interface select and device address (e.g., DEV.SELECT% = 701)
IOENTER (SELECT%, FORMAT\$, INFO[%or\$], RET.LENGTH, RET.STATUS%)	EOL\$	An end-of-line sequence that may be followed by "EOL"
IOEOL (SELECT%, EOL\$, RET.STATUS%)	FORMAT\$	Specifies byte, word, or character transfer "#,0123456789BKW" only
IOIFC (INT.SEL%, RET.STATUS%)	INFO[%or\$]	Integer or string data that is entered, output, or sent
IOLOCK (INT.SEL%, RET.STATUS%)	INT.SELECT%	An interface select code; 7 for the HP 150's built in IEEE-488 interface
IOLOCAL (SELECT%, RET.STATUS%)	REG.NO%	A TMS9914A register number (0 to 7)
IOOUTPUT (SELECT%, FORMAT\$, INFO[%or\$], RET.STATUS%)	REG.VAL%	The value read from or written to a TMS9914A register (0 to 255)
IOREMOTE (SELECT%, RET.STATUS%)	RET.LENGTH%	The number of characters or bytes returned in INFO (0 to 255)
IORESET (INT.SEL%, RET.STATUS%)	RET.STATUS%	The status returned by the library at the end of the call
IOSEND (INT.SEL%, DAT.CMD%, INFO\$, RET.STATUS%)	SELECT%	An interface select or an interface select combined with a device address
IOSPOLL (DEV.SELECT%, SPOLL.VAL%, RET.STATUS%)	SPOLL.VAL%	The status byte returned from the device
IOSTATUS (INT.SEL%, REG.NO%, REG.VAL%, RET.STATUS%)	TIME.VAL%	A period in milliseconds; unsigned integer
IOTIMEOUT (SELECT%, TIME.VAL%, RET.STATUS%)		
IOTRIGGER (SELECT%, RET.STATUS%)		
IOWAIT (TIME.VAL%, RET.STATUS%)		

* SUBJECT: POWER MOSFET SOURCING

* TO: MOTOR CONTROL AND POWER SUPPLY DESIGN ENGINEERS

* FROM: COMPONENT ENGINEERING DEPARTMENT

* PROBLEM: WE HAVE TO COME UP WITH A RELIABLE SOURCE FOR ALL OUR POWER MOSFETS. THE CRITERIA FOR SELECTION: 1. WE CAN'T SETTLE FOR ANYTHING LESS THAN THE HIGHEST PERFORMANCE MOSFETS. 2. WE WANT TO DO BUSINESS WITH A COMPANY THAT CAN SUPPLY OUR OTHER KEY POWER SEMICONDUCTORS. THEY REALLY HAVE TO UNDERSTAND OUR POWER SUPPLY/MOTOR CONTROL NEEDS.

* SOLUTION: UNITRODE. THEY ARE THE COMMITTED SOURCE FOR THE HIGHEST PERFORMANCE POWER MOSFETS IN THE MARKET - SEE THE CHART. THAT MEANS THEIR MOSFETS ARE TOTALLY INTERCHANGEABLE FOR ALL OUR APPLICATIONS. UNITRODE'S A RECOGNIZED LEADER IN POWER SUPPLY AND MOTOR CONTROL COMPONENTS (PWM IC'S, TRANSISTORS, FAST-RECOVERY RECTIFIERS, ETC.) WE CAN COUNT ON THEM FOR PRODUCTS, AS WELL AS SERVICE AND SUPPORT. ALSO, WITH THEIR LOW .01% AQL WE CAN ELIMINATE INCOMING INSPECTION.

-DON

* MOSFET COMPARISON	UNITRODE	IR	MOTOROLA	SILICONIX	SIEMENS
BV_{dss} - 60V TO 500V	✓	✓	✓	✓	✓
I_d - 4A TO 40A	✓	✓	✓	✓	✓
LOWEST $R_{DS(on)}$ PER UNIT AREA	✓	✓			
LOWEST INPUT CAPACITANCE	✓	✓			
AQL'S $\leq .01\%$	✓	✓			
TRUE PRODUCT INTERCHANGEABILITY	✓	✓			
MOSFET QPL APPROVAL	✓	✓			
* OTHER FACTORS					
OFFER WIDE RANGE OF ULTRA-FAST RECTIFIERS	✓		✓		
EXPERIENCED IN POWER SUPPLY AND MOTOR CONTROL APPLICATIONS	✓		✓		
OFFER WIDE RANGE OF PWM POWER SUPPLY AND MOTOR CONTROL IC'S	✓				

* THE CHART SPEAKS FOR ITSELF
LET'S GO WITH UNITRODE.



UNITRODE

THE POWER IS IN OUR SOLUTIONS

For more information, contact the following Unitrode Field Offices: Northeast, (Boston) 617-245-3010; Metro - New York 516-271-3110; Southeast, (Tampa) 813-932-5807; Midwest, (Chicago) 312-394-5240; North Central, (Dayton) 513-294-1364; Southwest, (Dallas) 214-231-8700; Southern California, (Los Angeles) 818-705-8085; (Orange County) 714-730-1077; Northern California, (San Jose) 408-294-4210.

PERSONAL COMPUTER SERIES



and stops.

Typically, an actual application program would take elaborate action based on the three categories of return statuses. Incidentally, converting the 16-bit integer—

which represents the value of the return status—into a hexadecimal format shows that the most significant byte of nonfatal returns always equals zero.

Similarly, the most signifi-

cant byte of format or syntax errors always equals 80₁₆ and the most significant byte of time-out returns always equals C0₁₆. Thus to branch to the appropriate error-handling routine, the application

Table 3. Status returns to the library

Nonfatal		Format or syntax		Bus Time-outs	
Status number	Description	Status number	Description	Status number	Description
0	No error (returned by all calls)	-32767	HPEL self-test failure (initializing)	-16383	Time-out before UNL command
		-32766	IOCONFIGURE has not been called	-16382	Time-out after UNL command
1	EOL and EOI match; terminated before maximum characters received	-32765	HPEL self-test failure (running)	-16379	Time-out before MTA command
2	EOL match EOI mismatch; terminated before maximum characters received	-32764	Invalid interface select code	-16378	Time-out after MTA command
3	EOL match, EOI mismatch; terminated before maximum characters received	-327 - 163	Invalid primary address (0 to 29)	-16375	Time-out before MLA command
4	EOL mismatch, EOI match; terminated on EOI	-32762	Interface select code 7 only	-16374	Time-out after MLA command
		-32761	FORMAT is a null string	-16370	Time-out after TALK command
5	EOL mismatch, EOI match; terminated on maximum character received	-32760	Invalid character in FORMAT	-16367	Time-out after LISTEN command
6	EOL mismatch, EOI mismatch; terminated on receipt of EOI	-32759	A number with B in FORMAT	-16363	Time-out after LISTEN command
		-32758	A number with W in FORMAT	-16366	Authorization module time-out
7	EOL mismatch, EOI mismatch; terminated on maximum character received	-32757	FORMAT contains a K with B	-16362	Time-out before sending data
8	Terminated on unexpected EOI with maximum characters received	-32756	FORMAT contains a W with B	-16361	Time-out after sending data
9	Terminated on maximum characters received	-32755	FORMAT contains a K with W	-16358	Time-out before DCL command
		-32754	No FORMAT type specified: B, K, or W	-16357	Time-out after DCL command
10	Terminated on EOI maximum characters not received	-32753	ACTION is greater than 0	-16354	Time-out before SDC command
11	TMS9914A register 0 not = 0 in the reset state	-32752	REG value must be 0 to 255	-16353	Time-out after SDC command
12	Another controller is asserting the ATN line	-32750	INFO is a null string (IOENTER)	-16350	Time-out waiting to enter data
		-32749	INFO is a null string (IOSEND)	-16348	Time-out before LLO command
13	Byte out bit not set by TMS9914A in controller mode	-32748	No primary address specified	-16347	Time-out after LLO command
14	ATN line not asserted by TMS9914A in controller mode	-32747	Invalid register number (0 to 7)	-16344	Time-out before SEND command
		-32746	FORMAT character count > 255	-16343	Time-out after SEND command
				-16340	Time-out before SPE command
				-16339	Time-out after SPE command
				-16336	Time-out entering SPOLL value
				-16334	Time-out before SPD command
				-16333	Time-out after SPD command
				-16330	Time-out before UNT command
				-16329	Time-out after UNT command
				-16326	Time-out before GET command
				-16325	Time-out after GET command
				-16322	Time-out initializing system
				-16317	Time-out before GTL command
				-16316	Time-out after GTL command

Program EPROMs, E²PROMs, and single-chip microprocessors.

\$1,995 to \$1,995*

One price covers all your programming needs. Our Model 824 has a built-in UV eraser, 64K of RAM, a 40-pin socket for microprocessors, and a 28-pin socket for EPROMs and E²PROMs up to 512K bits. Program current and future devices without adapters, and without extra cost.

When new devices come on the market, you will be updated in just a few seconds. Snap in a new Software Pack and you're ready to program. No chips to handle, no need for a service center.

The Model 824 can be operated remotely, or it can be taken to remote places—the rugged case is equipped with a flip-out handle.

Free Remote Control Software!

Order before December 31, 1984 and get Softlink—a software package that links your Model 824 Programmer to an IBM-PC®. A \$195 value! Call now for a demonstration.

Sure there are other programmers that start at \$1995. But the Model 824 also stops there—as we'll gladly demonstrate. Just call or write WAVETEK-DIGELEC, 586 Weddel Drive, Suite #1, Sunnyvale, California 94089. Tel: [408] 745-0722 TLX: 821-877 DIGELEC SUVL

*U.S. Prices Only

IBM-PC is a registered trademark of IBM

CIRCLE 104 FOR LITERATURE

CIRCLE 105 FOR DEMONSTRATION



PERSONAL COMPUTER SERIES



program need only perform a logical AND on the returned status. If the return indicates a time-out error, say, the program could inform the operator that a particular instrument has failed to respond and check that it is energized and connected to the bus.

As noted, the software library allows the 150 to be

used as a touch-screen instrument controller. An application program can thus be designed so that the user controls an entire instrument system without touching the computer's keyboard. Using a series of nested touch screens, an operator need be presented only with the specific choices to be made at any given time.

That simplifies running the system and reduces the chance of errors.

A programmer sets up the computer's screen by defining display areas that, when touched, initiate a particular action. Of the two types of keys available, the first is the traditional function keys, F1 through F8, located on the

Program 1. Calling the library

```
100 /
110 / Set up the variables needed to enter data from the multimeter
120 /
130 MULTIMETER% = 723 / The multimeter is device 23
140 FORMAT$ = "K" / Specify entering character data
150 VOLTSS$ = SPACE$(20) + "" / Set up string variable to receive the data
160 /
170 / Enter the voltage reading from the multimeter
180 /
190 CALLS IOENTER ( MULTIMETER%, FORMAT$, VOLTSS$, RET. LENGTH%,
RET.STATUS%)
200 /
210 / Check that the call to IOENTER was successful
220 /
230 IF RET. STATUS% > -1 THEN GOTO 290
240 /
250 / The call to IOENTER was not successful, inform the operator
260 /
270 PRINT "IOENTER RETURN STATUS EQUALS "; RET.STATUS%
280 STOP
290 /
300 / Set up the variables needed to transmit the data to the printer
310 /
320 PRINTER% = 701 / The printer is device 01
330 FORMAT$ = "K" / Specify output character data
340 VOLTSS$ = LEFT$ ( VOLTSS$, RET.LENGTH%) + " " + TIMES$
350 /
360 / Transmit the data with time to the printer
370 /
380 CALLS IOOUTPUT ( PRINTER%, FORMAT$, VOLTSS$, RET.STATUS%)
390 /
400 / Check that the call to IOOUTPUT was successful
410 /
420 IF RET.STATUS% = 0 THEN GOTO 100 / Do it again
430 /
440 / The call to IOOUTPUT was not successful, inform the operator
450 /
460 PRINT "IOOUTPUT RETURN STATUS EQUALS "; RET.STATUS%
470 STOP
480 END
```


POWER LINEAR FROM THE WORLD LEADER

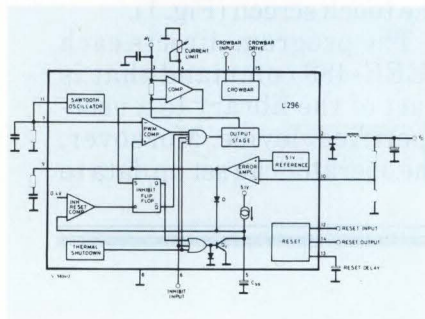


160W SGS switching regulator proven in millions of power supplies.

Immediate availability, world standard packaging and exceptional power make L296 device No. 1 design-in choice.

The reason why more design engineers are specifying the L296 step-down switching regulator can be summed up in two words: power and efficiency.

The 160W linear device employs pulse width modulation techniques to deliver regulated voltages from 5.1V to 40V.



L296 BLOCK DIAGRAM

(Compare this to 30V max. output for competitive types.)

The L296 provides high efficiency (up to 90%) at switching frequencies of up to 100kHz. This means lower dissipation, a smaller heatsink and, consequently, a smaller, less expensive power supply.

In fact, all necessary circuitry to build a complete switchmode power supply is housed in the IC's cost-saving plastic Multiwatt® package.

In addition, the L296 includes more control/protection functions, while requiring fewer external circuits. For example, only one capacitor and one resistor are needed for the device's reset circuit to provide a signal to the microprocessor. Plus, with most other switching regulators, an external current limiter must be added; this function is standard in the L296. Soft-start, internal precision reference and overload output protection are also part of the high performance L296 package.

To date, millions of L296 switching regulators are on the job in a host of products including monitors, printers, personal computers and typewriters. The SGS device is in demand because of its exceptional power

A TYPICAL SYSTEM PERFORMANCE		
Characteristic	Rating	
Input Voltage	$V_i = 7.5 \text{ to } 50\text{V}$	
Line Regulation	$V_i = 10\text{V to } 40\text{V } I_o = 2\text{A}$	60dB
Load Regulation	$V_i = 20\text{V } I_o = 0.3\text{A to } 4\text{A}$	60dB
Ripple Rejection	$f = 120\text{Hz}$	60dB

and its proven track record. In short, the L296 is simply the logical choice for engineers who can't afford to gamble on their power supply design.

L296 evaluation kit now available from SGS.

The kit, which is available for immediate shipment, includes an L296, PC board and layout information as well as detailed application notes. To order, send a \$10 check to SGS Semiconductor Corporation, Product Marketing, 1000 E. Bell Road, Phoenix, AZ 85022. Or call 602/867-6262.

Multiwatt is a registered trademark of SGS Semiconductor Corporation.

Created by Martz & Associates

PERSONAL COMPUTER SERIES



keyboard and found on all IBM-type personal computers. The 150 also displays these keys, along with their user-defined labels, on the lower portion of the touch screen. Thus they may be activated by using either the keyboard or the touch screen.

The second type of key is unique to the 150 and is known as a touch key. Unlike function keys, they may be placed anywhere on the screen and can be made any size. Like their counterparts, they also may be assigned user-defined labels.

A perfect fit

Touch keys can be tailored by the programmer to suit a specific application. They may, for example, be set up as normal or inverse video, at full or half brightness, and as steady or blinking. Moreover, when the key is touched the attributes can be changed. For example, a key could be configured for half brightness and inverse video. When touched, though, it could change to full brightness, with blinking inverse video.

A GW-Basic program that defines two touch keys, and takes a specific action when either one is touched, illustrates how they are programmed (Program 2). Lines 190 through 280 define the parameters for the first key.

They assign values to the variables that will be passed to the **SCREEN** statement in line 370. Line 270 establishes the way in which the keys will respond. A key can be activated by touch only (as in this program), release only, or both touch and release.

Lines 320 through 370 create the first touch key. The **ON KEY** statement in the first of those lines jumps the program to the subroutine at line 620 when the program returns a key code of 27. That occurs when the first key is activated. Line 350 prints a label on the screen where the first key will be displayed, and line 370 generates the key display. That done, the first touch key appears.

Unlocking the second key

To define the second touch key, lines 410 to 450 change the value of the parameters passed to the screen statement in line 540. Only the upper left corner, lower right corner, and key-code parameters are modified. Doing so makes the second key slightly larger than the first and places it in the middle of the screen. Lines 490 to 540 draw the second key.

A tight loop, in which the program waits for a touch key to be activated is represented by lines 580 to 600. If the first key is activated, as noted, the

program jumps to the subroutine starting at line 620. That service routine erases any previous message, indicates that the first key was activated, displays the time, and then returns to the point of interruption in the wait loop. Lines 700 through 760 represent the equivalent service routine for the second key.

Just one touch

The touch screen instrument control program, that is included on the package disk, makes extensive use of the library routines. Employing it, a user can communicate with and control a number of IEEE-488 instruments without writing a single line of code.

The program is installed under Hewlett-Packard's personal applications manager, which allows it to be loaded and run with the single touch of a finger. When the program is started up, a main menu is displayed that offers the user a choice of operating modes. One, for general instrument control, enables multiple instruments to be simultaneously controlled by the touch screen (Fig. 1).

The program directs each IEEE-488 command that is part of the library to a user-specified device. Moreover, the operator can set up data to



IS YOUR COMPANY STILL STRUGGLING TO MAKE ENDS MEET?

Flat ribbon cable is a real time saver. That is, until you have to connect it to your plant wiring.

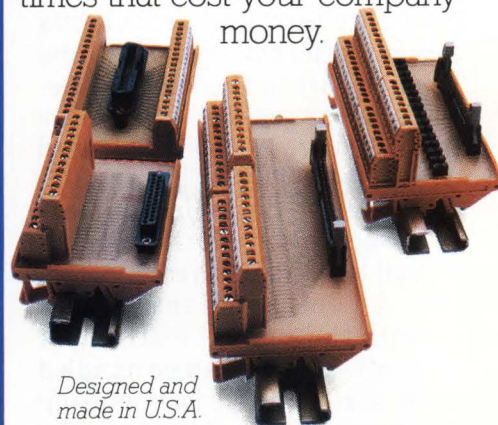
That's when the most important connection you've got will be the one you've made with Weidmuller.

We've developed a series of rail-mounted ribbon cable interface modules that provide fast, reliable connections in a minimal amount of space. These modules incorporate Weidmuller's proven PC terminal blocks and are available for IDC, D Subminiature and DIP connectors.

And, like other popular Weidmuller products, they're designed and made in the U.S.

Weidmuller offers a comprehensive line of terminal blocks and connectors, including relay socket assemblies, diode arrays, opto isolators and relay modules. And, if our standard units can't solve your problem, we'll help you design one that will.

So make the connection with Weidmuller today. And put an end to long installation times that cost your company money.



*Designed and
made in U.S.A.*

Weidmüller

Write Weidmuller Terminations, Inc., 821 Southlake Boulevard, Richmond, Virginia 23236. Phone (804) 794-2877. Telex: 828376.

CIRCLE 87

PERSONAL COMPUTER SERIES



be transmitted to and entered from multiple devices periodically. Information entered from the devices is displayed on the screen.

Five areas on the screen are separated by lines drawn using the computer's alternative character set. The top area holds the title, and the bottom contains the function keys and the standard 150 status information. The remaining area of the screen is reserved for the 15 touch keys and for displaying the library call status.

Data going to or coming from the selected instrument is displayed in the center of the screen. As many as four lines are available whenever the program prompts the user for an input.

Complete with address

The bottom center box shows the return status from each call to the library. Because several instruments may have AUTO INPUT and AUTO OUTPUT active simultaneously, the device address associated with the current call is also displayed.

An operator's interaction with the general instrument control screen can be handled as simply as serially polling an instrument. Alternatively, it can be as complex as automatically sending and receiving information period-

Program 2. Defining touch keys in GW-Basic

```
100 ' Clear the screen, disable touch fields, and name the program
110
120 CLS 0 ' Clear the alpha and graphics screens
130 SCREEN 255 ' Clear all existing touch fields
140
150 PRINT "Example TOUCH SCREEN program"
160
170 ' Define first touch key's parameters
180
190 SC.SET.TOUCH% = 4 ' Set touch field mode (always 4)
200 ROW.UP% = 0 ' Top of touch field (0 to 47)
210 COL.UP% = 69 ' Left side of touch field (0 to 79)
220 ROW.LO% = 2 ' Bottom of touch field (0 to 47)
230 COL.LO% = 79 ' Right side of touch field (0 to 79)
240 SC.BEEP% = 1 ' 1 enables beep on touch; 0 disables beep
250 INH.OFF% = 10 ' Half bright, blinking box before touch
260 INH.ON% = 2 ' Full bright when touched
270 SC.REPORT% = 1 ' Report on touch
280 KEY.CODE% = 27 ' ON KEY key code for touch (25 TO 29)
290
300 ' Transmit the screen parameters for the first touch key
310
320 ON KEY (27) GOSUB 620 ' Define touch key subroutine for key 29
330 KEY (27) ON ' Turn on the touch key
340 LOCATE 2, 72 ' Position for key label
350 PRINT "KEY # 1" ' Label the first key
360
370 SCREEN SC.SET.TOUCH%, ROW.UP%, COL.UP%, ROW.LO%, COL.LO%, SC.BEEP%,
    INH.OFF%, INH.ON%, SC.REPORT%, KEY.CODE%, "Transmit KEY # 1 parameters"
380
390 ' Change parameters to define the second touch key
400
410 ROW.UP% = 10 ' Top of touch field
420 COL.UP% = 30 ' Left side of touch field
430 ROW.LO% = 14 ' Bottom of touch field
440 COL.LO% = 40 ' Right side of touch field
450 KEY.CODE% = 28 ' Key number of the touch field
460
470 ' Transmit the screen parameters for the second touch key
480
490 ON KEY (28) GOSUB 700 ' Define the touch key subroutine
500 KEY (28) ON ' Turn on the touch key
510 LOCATE 13, 33 ' Position for key label
520 PRINT "KEY # 2" ' Label the second key
530
540 SCREEN SC.SET.TOUCH%, ROW.UP%, COL.UP%, ROW.LO%, COL.LO%, SC.BEEP%,
    INH.OFF%, INH.ON%, SC.REPORT%, KEY.CODE%, "Output KEY # 2 parameters"
550
560 ' Wait for a key to be touched
570
580 LOCATE 23, 1 ' Position cursor for wait-loop label
590 PRINT TIMES; " WAITING for touch entry (depress Cntl C to exit)"
600 GOTO 580 ' Loop here until touch or exit
610
620 ' KEY # 1 service routine
630
640 LOCATE 22, 1 ' Position cursor for clearing old display
650 PRINT SPACES (70) ' Clear old display
660 LOCATE 22, 1 ' Position cursor for response message
670 PRINT "TOUCH KEY number one has been touched "; TIMES
680 RETURN
690
700 ' KEY # 2 service routine
710
720 LOCATE 22, 1 ' Position cursor for clearing old display
730 PRINT SPACES (70) ' Clear old display
740 LOCATE 22, 1 ' Position cursor for response message
750 PRINT "TOUCH KEY number two has been touched "; TIMES
760 RETURN
770
780 END
```


Tiny BASIC MICROCOMPUTER

K-8073A

The Engineer's Product Development Board Level Computer

LOW COST

POWERFUL/VERSATILE

ENGLISH-LIKE PROGRAMMING

EXPANDED

NEW!
FIRST
TINY BASIC
MPU

NOW
FASTER
AT
8 MHz

2K Byte Local RAM
Expandable To 8K On-Board
Ext. Expandable 24K

ART/RC Master, For Single
Wire Data I/O Of 128 Slave Units

Real-Time Clock
W/Ext. Battery Backup
Yr, Mo, Wk, Day, Hour, Sec.
CPU Time Interrupt

RS-232 For CRT
110—4800 Baud
W/Handshake
To CPU

STD (MOD) BUS 4.5 x 6.5 in.
5 Volt Only—Cassette
Tape In/Out—2 Sense—
3 Flags—RS-232—Address/
Control Lines

INS8073 Microinterpreter
Tiny BASIC Processor
4 Or 8 MHz Version

Autostart EPROM 2K Byte
Or 2K Byte RAM

Utilities Firmware, For
Software Dev., EPROM Or
RAM 2K

EPROM Or RAM—2K Byte

EPROM Programmer, 2K
Byte Pgm. Decoded—Req.
Ext. 25V Only

PPI, Programmable I/O,
24 Lines

PPI Interface Ribbon
Connector

THINK
TINY
BASIC

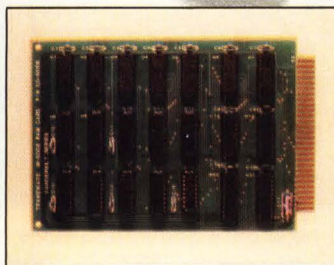
\$388
SINGLE UNIT

K-8073A

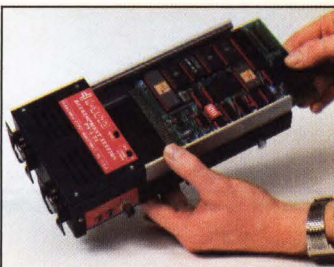
THOUSANDS OF TRANSWAVE K-8073 COMPUTERS

are used throughout the world in numerous OEM applications. Why? Because it is a powerful, cost-effective solution to many industrial measurement/control problems. Regardless of your discipline or software skills, the K-8073A is a favorite among engineers. Simply attach a CRT, connect 5 volts (or use our inexpensive Development Station), and you have yourself one powerful, versatile microcomputer that YOU can program. With an on-chip microinterpreter and the extra control devices we designed into the board, you can do your own programming in the most simple English-like language available—Tiny BASIC. Sophisticated application designs can be implemented in hours instead of days or weeks because you have eliminated expensive and time-consuming hardware and software costs.

IN ADDITION TO ALL THIS, THE NEW K-8073A OFFERS more features than the original K8073 board. *Two times faster* at 8 MHz, a Real-Time Clock, Program Autostart, 2K-8K Byte Local RAM, 8K Byte EPROM with Programmer, 128 Remote Addressable ART/RC and PPI W/24 Line I/O.



16K Byte RAM M-8016B \$305.00



Development Station PS-5/25 \$225.00

THE K-8073A IS FOR OEMs AS WELL AS END USERS.

Whether you manufacture Industrial Process Control, Environmental or Test/Measurement systems, or simply for your own use, you can count on cost-effective performance. The K-8073A comes complete with all socketed devices including the powerful F-2.3 Utilities Firmware and a Hardware/Software manual.

In Industry, Education or New Product Development, the K-8073A provides you with state-of-the-art technology. With a full line of support products, Transwave takes care of your every need at the most reasonable prices.



TRANSWAVE CORPORATION

Cedar Valley - Box 489, Vanderbilt, PA 15486
(412) 628-6370

For orders and information only:
(800) 245-6843/Telex 902992

International inquiries please write direct to
Transwave for complete product guide.

PERSONAL COMPUTER SERIES



ically from a number of instruments.

To serially poll a device, the operator only needs to perform three steps. First, the user touches the **DEVICE ADDR** key. The program responds by requesting the address with the prompt **DEVICE ADDRESS =** on the line below that for **SPOLL DATA =**. The device's address is then en-

tered using the keyboard, and the program updates the **DEVICE ADDR** key. Finally, the operator touches the **SPOLL** key.

The program then puts in a call to the library to obtain the serially polled data for the device. The information is displayed in decimal and hexadecimal notation on the **SPOLL DATA =**

line. The **RETURN STATUS =** and **DEVICE ADDRESS =** lines are also updated to reflect the results of the serial poll operation.

Sending data to an instrument at a periodic rate is equally straightforward: First, the device is selected as in the above description. Second, the operator touches the **SPECIFY OUTPUT STRING**

Touch Screen Instrument Control					
DEVICE ADDR 23	AUTO OUTPUT RATE 1 Sec	SPECIFY OUTPUT STRING	AUTO OUTPUT ON/OFF	SINGLE OUTPUT	
TIMEOUT VALUE 1 Sec	AUTO ENTRY RATE 1 Sec		AUTO ENTRY ON/OFF	SINGLE ENTER	
EOL SEQUENCE 13 10	OUTPUT DATA = D2*OPTIMATICS* INPUT DATA = +07.7983E+0 SPOLL DATA = 1 (10) 1 (16)			SPOLL	
LOCAL REMOTE REMOTE (LLO)	Optimatic Solutions, Inc. HP-IB Enhancement Library Return Status = 1 Device Address = 23			TRIGGER	
RETURN TO MAIN MENU				CLEAR	
GENERAL CONTROL	3478 A DMM	OTHER DEVICE	OTHER DEVICE	22 62	END OF DEMO
		Num Pad		20:59	CAPS

1. The 15 touch keys on a general-purpose menu for instrument control allow a user to manage one or more IEEE-488 devices without writing any software. When the **AUTO OUTPUT** and **AUTO ENTER** keys are touched, the program periodically sends data to and receives data from one or more instruments at rates specified by the user.

How Datel converts analog signals and design engineers at an amazing rate.

Design engineers responsible for the development of high-speed/high-accuracy data acquisition systems have, for many years, specified Datel conversion components.

But the incredible speed and exceptional accuracy aren't the only reasons Datel has attracted a loyal following among design engineers. Manufactured with state-of-the-art thin film hybrid technology and active laser trimming, Datel A/D Converters are also respected for their stability and reliability.

12 Bit, 2 μ sec

If you're looking for high speed, look at our ADC-810 hybrid, successive approximation A-D. It features $\pm 1/2$ LSB differential linearity and no missing codes over temperature; four pin programmable input voltage ranges; and an optional input buffer amplifier.

CIRCLE 89

Datel's ADC-810 is most often used in automatic test instrumentation, guidance and control avionics and high-speed multiplexed data acquisition systems.

8 Bit, 700 nsec

For ultra-fast conversion, try our hybrid ADC-815. In addition to conversion rates up to 1.67 MHz, six programmable input voltage ranges are offered.

It's been designed for pattern recognition, telecommunication, fast servo, radar, instrumentation, automatic control and data acquisition applications.

One of the unique features of the ADC-815 is a logic input which switches the converter from unipolar to bipolar operation. Output coding is binary, offset binary, or two's complement.

12 Bit, 500 nsec

High accuracy and ultra high speed

are packaged together in our modular ADC-868. No external components are required. It features on-board gain and offset adjustments and internal analog and digital supply decoupling capacitors to simplify installation and calibration.

The ADC-868 is best suited for test and measurement systems, performing spectrum analysis, analyzing real time waveforms, industrial testing, radar digitizing and digital communications.

NOTE: For military and aerospace applications Datel's Hybrid ADCs can be subjected to rigorous screening procedures in accordance with MIL-STD-883, method 5008, Class B.

For your FREE Engineering Data Sheets call 617/339-9341 Extension 121, or write Mr. Bob Leonard, Applications Engineer, Datel, 11 Cabot Boulevard, Mansfield, MA 02048.



DATEL

USA: 11 Cabot Boulevard, Mansfield, MA 02048
617/339-9341 TWX 710-346-1953 TLX 951340 •
Santa Ana, CA 714/835-2751 • Sunnyvale, CA
408/733-2424 • Los Angeles, CA 213/933-7256

Overseas: Datel/UK: Basingstoke (256) 69085 •
Datel/France: 602-57-11 • Datel/Germany:
(89) 530741 • Datel/Japan: (Tokyo) 793-1031
(Osaka) 354-2025

PERSONAL COMPUTER SERIES



key, causing the program to respond by requesting the ENTER OUTPUT STRING. At this point, the programmer enters the output data using the keyboard, and the program displays the data on the OUTPUT DATA = line.

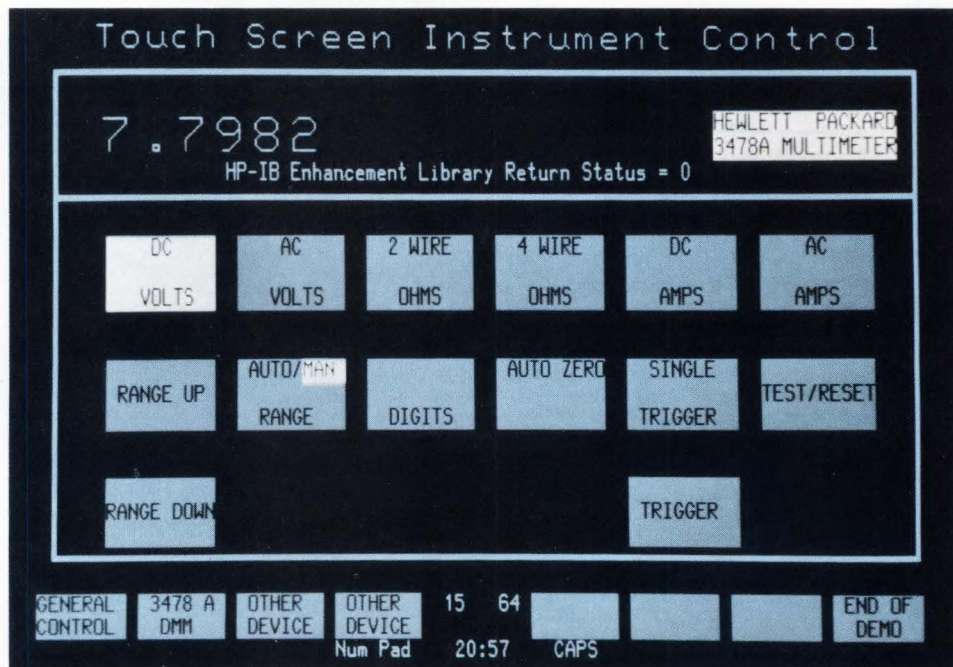
Next, the AUTO OUTPUT RATE key is touched, causing the program to react by asking for the ENTER OUTPUT RATE. That information is en-

tered using the keyboard. Finally, the program updates the rate displayed on the AUTO OUTPUT key.

The program now makes calls to the library's output routine at the interval specified by the user. For each call made, the result will be displayed in the software status area.

Another way to put the program to work is as a controller

for a specific instrument—the HP 3478A multimeter. Here, the program paints the front panel of the multimeter on the touch screen (Fig. 2). Thus the user can remotely control all of the front-panel functions of the instrument by simply touching the corresponding key on the screen. Taking the same approach, a user can build a custom control panel for a test system. □



2. One touch-screen display duplicates the front panel of an HP 3478A digital multimeter. By touching the appropriate keys, a user controls all of the multimeter's front-panel settings. All measurements appear in the upper left corner of the display.

One Glance Says 'Success' A Close Look Reveals Quality

Dressing for success makes good business sense. It works for you. It works for your new product or system.

Your customer may accept all your performance specs and your product's capabilities, but he'll make his *final* purchasing decision five times out of ten on how good your product looks.

Make certain you've taken the extra step to assure you've dressed your new idea for success. Demand Matrix IV Enclosure Systems from Zero. They're available in Vertical, Slope Front, and Desk Top styles, single or multi-bay configurations, and feature the broadest selection of tasteful and practical accessories and options.

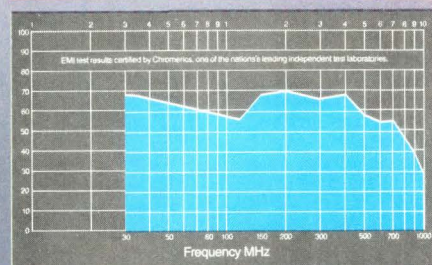
NOW AVAILABLE WITH EMI SHIELDING

Write for your validated test report on your company stationary. Then compare our results with the testing information available from lesser cabinet system suppliers.

THE PRICE OF SUCCESS IS SURPRISINGLY LOW.

The new Matrix IV Enclosure System is not only practical, versatile, and readily available. It's very affordable. Call today and find out how you can dress for success on a budget.

Remember. First impressions can make the difference. . . and first impressions last!



CALL TODAY.

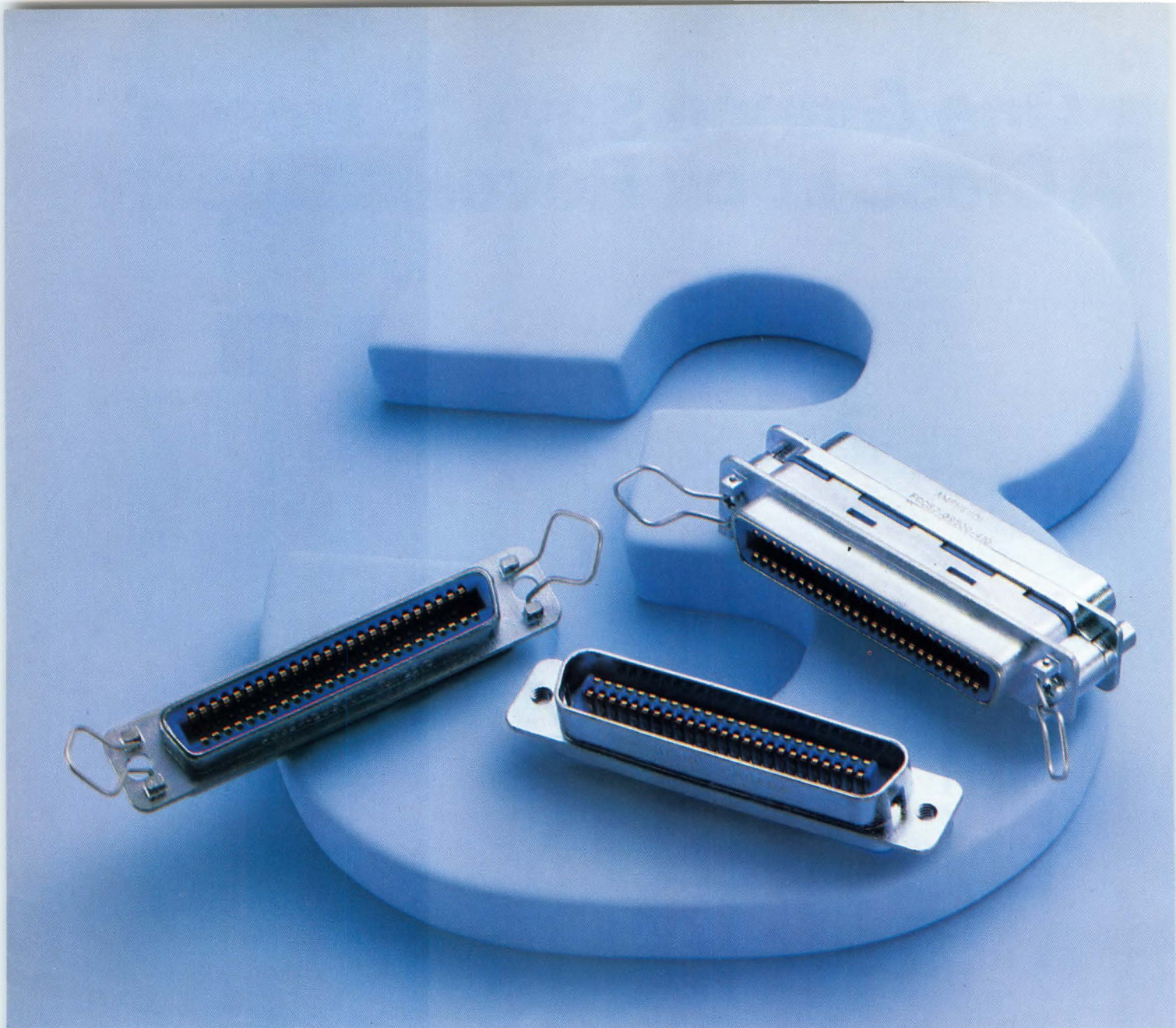
818 846-4191
413 267-5561



Burbank, CA 91503
Monson, MA 01057

CALL ME, I'M INTERESTED, CIRCLE 90
SEND LITERATURE, CIRCLE 91





We've cut the cost

With new Amphenol® FCC 17 Series and FCC 57 Series filter connectors.

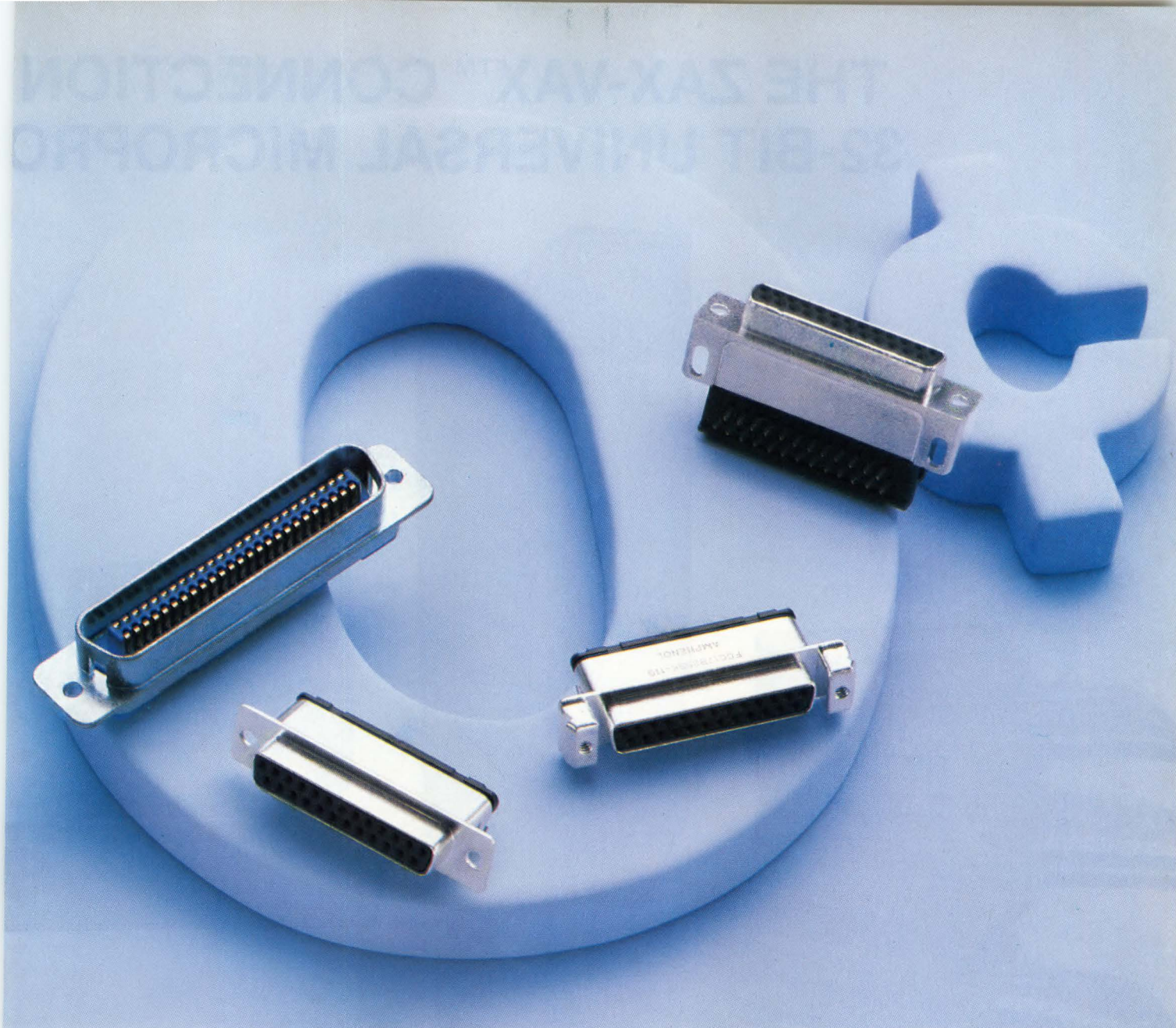
If you have a problem with FCC 20780 compliance, electrostatic discharge or EMI/RFI interference, we have a solution at a price much lower than you'd expect.

Amphenol filter connectors block radiated and induced I/O cable interference for less than 30¢ a line. That's less than half the price of most other filter connectors, and much

less cumbersome than shielded cable.

This low-cost breakthrough was achieved by combining our connector design expertise with the proven technology of chip capacitors as filter elements. With low power factor and long life, these filter elements are available in a broad range of capacitance values to meet your specific filtering requirements.

We've also made retrofitting easy by designing our filter connectors with the



© 1984 Allied Corporation

of EMI/RFI control.

same outer dimensions as our standard D-Subminiature and Micro-Ribbon® connectors. You can substitute filter connectors in existing designs without expensive modification.

The FCC 17 Series D-Subminiature filter connectors are available in 9, 15, 25 and 37 pin and socket designs. FCC 57 Series Micro-Ribbon filter connectors are available in plug, receptacle, and adapter versions with

36 or 50 contacts. Both series offer you a choice of solder cup, and straight or right angle PCB terminations.

For more information, technical assistance, prices and delivery...

Call 1-800-323-7299.

Amphenol Products world headquarters: Lisle, IL 60532

Connect with Amphenol Products
at Wescon/84—Booth 2289
Anaheim, CA October 30-November 1



ALLIED Amphenol
Products

CIRCLE 92

THE ZAX-VAX™ CONNECTION 32-BIT UNIVERSAL MICROPRO



BRINGS YOU THE FIRST, TRUE CESSOR DEVELOPMENT SYSTEM

ZAX Corporation is proud to introduce the first, true 32-bit Universal Microprocessor Development System, featuring ZAX in-circuit emulators and DIGITAL's newest super-micro-computer; the *MicroVAX™ I*. The *MicroVAX™ I* runs the MicroVMS™ computer systems from DIGITAL.

■ Multi-user

With the *MicroVAX™ I*, multi-user configurations (up to eight) are easily accomplished by simply adding a standard terminal and one or more ZAX in-circuit emulators.

■ Manufacturer Compatible Cross Assemblers

All software developed for ZAX is manufacturer compatible; you'll never lose a single line

of source code generated on slower, less capable development equipment.

■ C and Pascal

C and Pascal high-level language support from ZAX offer programming freedom and flexibility. Both Pascal and C Compilers have five different memory models for the 8086, vectored interrupt procedures, software and hardware floating points, and generate ROMable code for the 8086.

■ Intel Compatible PL/M 86 Compiler

For all Intel PL/M users, ZAX offers a fully Intel compatible PL/M-86 compiler. This compiler is available for our ZAX/*MicroVAX™* Development System, plus all of DIGITAL's VAX™ Computers, and the IBM PC.

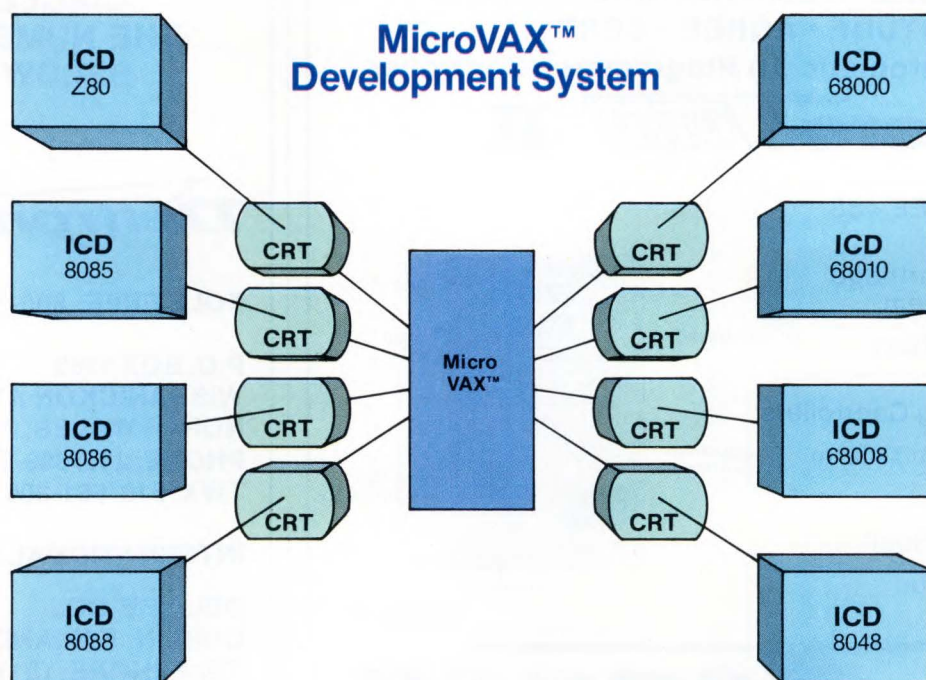
■ Hardware/Software Integration

If your development program is committed to microprocessor based design for 8086, 8088, 68000, 68010, 68008, Z80B, 8085, and 8048 family, ZAX can provide you with the most intelligent, flexible and affordable, in-circuit emulation equipment available today. And the ZAX emulator-*MicroVAX™ I* connection gives you full symbolic debugging capability as well; all symbols and labels from our C, Pascal and PL/M software are passed to our emulators.

If the ZAX-VAX™ connection sounds like something you'd want to link up with, call or write
ZAX Corporation,
800/421- 0982 • 714/474-1170.

VAX™, VMS™, MicroVAX™ I are trademarks of Digital Equipment Corporation.

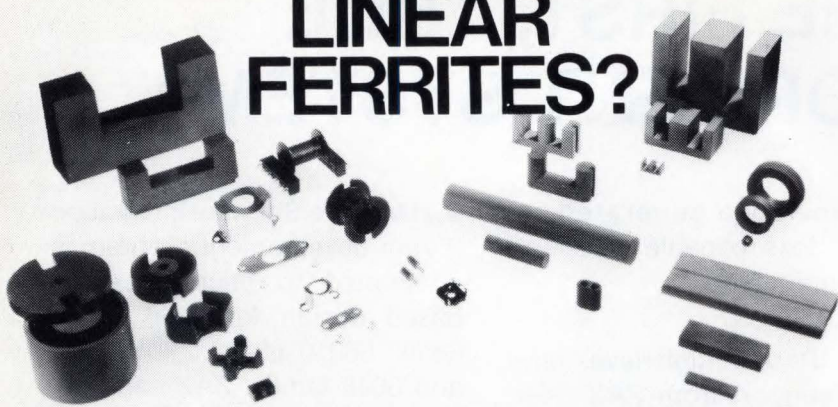
CIRCLE 115



ZAX

Zax Corporation 2572 White Road, Irvine, California 92714
(714) 474-1170 • 800-421-0982 • TLX 183829

LINEAR FERRITES?



We have the growing supplies to meet your growing demands.

From the finest mills worldwide: Indiana General, Siemens, Stackpole and Krystinel.

Permag supplies the largest selection of linear ferrites for electronics, telecommunications, the space and computer industries. What's more, our highly trained technicians answer your design and applications questions, and advise you on fabrication procedures.

And our fabrication procedures are the most sophisticated in the industry.

So keep up with the demand for linear ferrites. Demand linear ferrites. From PERMAG.

It's what we add that makes the difference.



PERMAG

PERMAG CORP.

400 Karin Lane, Hicksville, NY 11801

☐ Have salesman call

☐ Please send me your latest Linear Ferrites Catalog.

Name _____

Company _____

Address _____

City _____

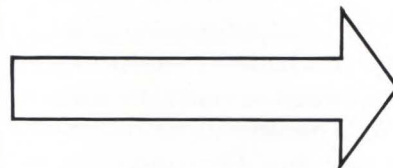
State _____

Zip _____

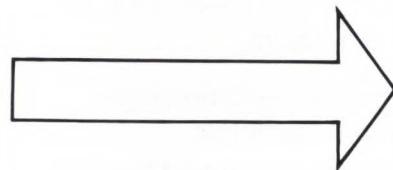
Phone _____

ED 10

ATTENTION POWER SUPPLY SPECIFIERS



**See Deltron's
New
Linear
Power Supply
Catalog**



**IF YOUR
COPY
IS MISSING,
CIRCLE
THE NUMBER
BELOW.**

Deltron inc.

TOLL FREE: 800-523-2332

**P.O. BOX 1369
WISSAHICKON AVENUE
NORTH WALES, PA 19454
PHONE: 215/699-9261
TWX: 510/661-8061**

INTERNATIONAL UNIT:

**DELAIRE CO.
DUBLIN, IRELAND
TELEPHONE: (01) 851411
TWX: 30442 DEL EI
PREFIXES: UK (0001)
INT. + 353 (1)**

Tenney CHAMBERS

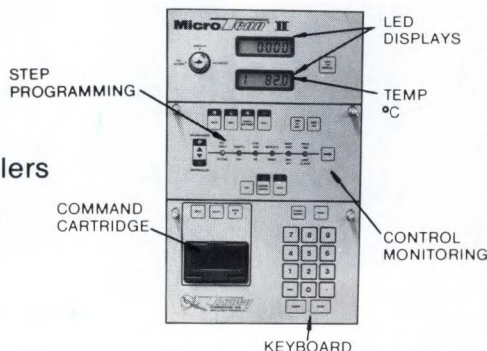
**TEMPERATURE • TEMPERATURE / HUMIDITY •
ALTITUDE • AGREE • CERT ...**

with Fully Automatic μ p Programmer/Controller

MicroLenn II

Features

- RS-232 or IEEE-488 Compatibility
- Command Cartridge Memory System
- Five Year Battery Backup
- Proportioning Controllers
- High/Low Limit Alarm
- LED Display
- Guaranteed Soak
- Self Diagnostic



CIRCLE 93



Tenney

ENGINEERING, INC.

The Largest and Most Experienced Manufacturer of High Technology Environmental Test Equipment
1090 Springfield Rd., P.O. Box 3142, Union, New Jersey 07083 • (201) 686-7870

See us at Wescon/84, booths 1468/1470

CIRCLE 94



In October, Electronic Design has something extra for career-minded engineers

Career Extra is the industry's only recruitment newspaper for 118,000 professional engineers. Our career-oriented articles and interviews with leading Personnel Managers give readers a complete assessment of employment trends and opportunities.

Like which engineering titles are currently in demand. And by whom.

Which industries are on the rise and are bringing new employment opportunities. And which ones aren't.

The new strategies companies are

taking to overcome manpower shortages. And what alternative methods they're using to recruit working engineers.

News about career development centers and college relations programs.

Plus exclusive career studies surveying industry conditions, attitudes and opinions.

As an Electronic Design subscriber, you'll receive four issues of Career Extra in 1984. The next one's coming in October. Don't miss it!

Type TF Ultra-Precision Film Resistors from Caddock: Absolute Tolerances to $\pm 0.01\%$ with TC's to 5 PPM/ $^{\circ}\text{C}$ and Resistance Values from 1 kohm to 125 Megohms.



Models TF020R and TF626R
0.33 watts, 300 volts max continuous
Values from 1 kohm to 35 Megohms



Models TF050R and TF656R
0.75 watts, 1400 volts max continuous
Values from 10 kohms to 125 Megohms

Caddock's Tetrinox® resistance film technologies achieve unique ultra-precision resistor performance.

Tetrinox®—Caddock's advanced resistance film technology—combined with high-thru-put manufacturing technologies, results in a unique approach to the production of ultra-precision resistors.

The Type TF resistors utilize these technologies to provide a highly producible ultra-precision resistor with low temperature coefficients, high stability and an extended resistance range.

Resistance values up to 125 Megohms provide a new design element.

The exceptionally wide range of resistance values from 1 kohm to as high as 125 Megohms make the Type TF Ultra-Precision Resistors ideal for new design opportunities.

And in existing designs, Type TF resistors are widely used to replace ultra-precision wire-wound resistors. For purposes of price comparisons with ultra-precision wire-wound resistors, here are representative Type TF prices in 2500-unit quantities:

Model No.	Resistance	Tolerance	TC	Unit Price
TF 020 R-	1 k	-0.01%-10 PPM/ $^{\circ}\text{C}$		\$2.67
TF 020 R-	10 k	-0.01%-10 PPM/ $^{\circ}\text{C}$		\$2.67
TF 020 R-	100 k	-0.01%-10 PPM/ $^{\circ}\text{C}$		\$2.93
TF 020 R-	1 Meg	-0.01%-10 PPM/ $^{\circ}\text{C}$		\$4.94
TF 626 R-	10 Meg	-0.01%-10 PPM/ $^{\circ}\text{C}$		\$6.47

The high producibility and unit-to-unit consistency of Type TF resistors also assures 6-to-8 week delivery on even large production quantities, and many resistance values are available from stock.

Seven Absolute Tolerances from $\pm 1.0\%$ to $\pm 0.01\%$.

For maximum design flexibility, Type TF resistors are available in seven resistance tolerances:

$\pm 0.01\%$, $\pm 0.025\%$, $\pm 0.05\%$, $\pm 0.1\%$
 $\pm 0.25\%$, $\pm 0.5\%$ and $\pm 1.0\%$

This wide range of absolute tolerances gives circuit designers optimum price-performance characteristics in all applications.

Three Temperature Coefficients of 5 PPM/ $^{\circ}\text{C}$, 10 PPM/ $^{\circ}\text{C}$ and 15 PPM/ $^{\circ}\text{C}$.

The choice of three Absolute Temperature Coefficients - 5 PPM/ $^{\circ}\text{C}$, 10 PPM/ $^{\circ}\text{C}$ and 15 PPM/ $^{\circ}\text{C}$ - in all models and values of Type TF resistors permits each circuit's requirements to be achieved on an efficient performance versus cost basis.

These temperature coefficients apply over the temperature range of -15°C to $+105^{\circ}\text{C}$, referenced to $+25^{\circ}\text{C}$.

Type TF Resistance Range from 1 kohm to 125 Megohms

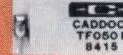
Model Number Radial Leads	Wattage @ $+70^{\circ}\text{C}$	Maximum Continuous Oper. Voltage	Resistance		Dimensions	
			Min.	Max.	Length	Height
TF 020 R	0.33	300	1 K	2 Meg	$0.75 \pm .020$	$0.375 \pm .020$
TF 050 R	0.75	1400	10 K	10 Meg	$1.50 \pm .020$	$0.50 \pm .020$
TF 626 R	0.33	300	2.01 Meg	35 Meg	$0.75 \pm .020$	$0.375 \pm .020$
TF 656 R	0.75	1400	10.01 Meg	125 Meg	$1.50 \pm .020$	$0.500 \pm .020$

Models TF 020 R and TF 626 R

Models TF 050 R and TF 656 R

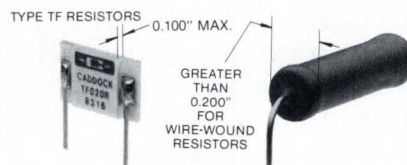


ALL DIMENSIONS
IN INCHES



Thin-profile Type TF resistors save installation space.

The thin profile of the Type TF resistors make them an ideal replacement for the large-bodied wire-wound resistors.



And the radial leads of the Type TF resistors also simplify their installation into PC boards.

Custom Type TF resistors with special performance and configurations can achieve optimum cost-effectiveness.

In many medium-to large-volume applications, there can often be additional cost savings when the Type TF resistors are

optimized for voltage rating, power rating, size and lead spacing.

The examples of custom Type TF resistors shown here include the same choices of absolute tolerance, temperature coefficient and resistance value that are available in the standard radial-lead Type TF Ultra-Precision Film Resistors.

Discover how easily these problem-solving resistors can improve the performance and reliability of your equipment, too. For your copy of the latest edition of the Caddock 24 page General Catalog, and specific technical data on any of the more than 150 models of the 13 standard types of Caddock High Performance Film Resistors and Precision Resistor Networks, just call or write to -
Caddock Electronics, Inc., 1717 Chicago Avenue, Riverside, California 92507 • Phone (714) 788-1700 • TWX: 910-332-6108

CADDOCK

HIGH PERFORMANCE FILM RESISTORS

Systolic array chip matches the pace of high-speed processing

A monolithic systolic array packs 72 single-bit parallel processors, letting it clip along at the rates demanded to process images in real time.

This is the first in a series dealing with systolic arrays. Subsequent articles will investigate such applications as pattern recognition, image manipulation, and data-base management.

The herculean demands of real-time image processing, automated inspection, and artificial intelligence clearly reveal the limitations of the traditional von Neumann machine. Since that architecture handles only one piece

of data at a time, it severely constrains the speed with which information can be processed. Further, because incoming data must be held until it can be put to use, the approach inherently calls for a large amount of memory.

Some problems are alleviated by turning to parallel architectures, in which microprocessors or semicustom devices are linked. The

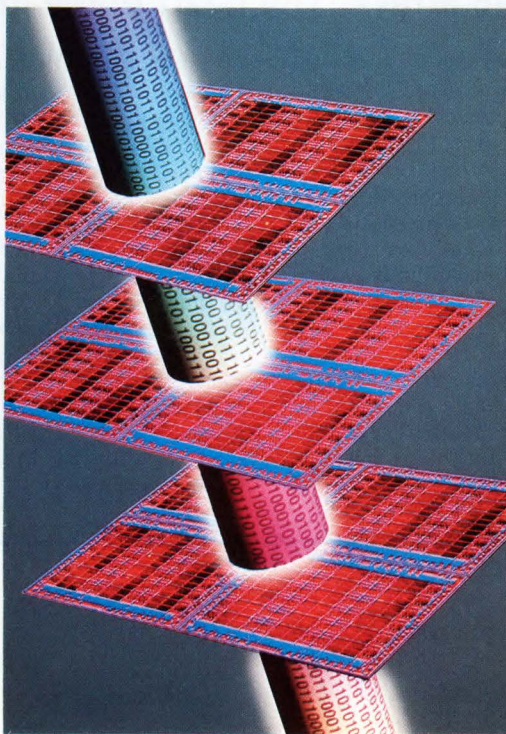
sheer number of components involved, though, makes the size of such systems an obstacle in its own right. In short, one set of difficulties is traded off for another. What's more, parallel processing does little to cut back on storage space.

A solution is finally at hand, in the form of the first commercial systolic array processor chip. The Geometric Arithmetic Parallel Processor (GAPP) overcomes the intrinsic problem associated with the von Neumann computer by loading 72 bit-serial parallel processor cells onto a single IC (see "Systolic Arrays: The Heart of the Matter," p. 208). Each of

Ronald Davis and Dave Thomas, NCR Corp.

Ronald Davis is a product marketing engineer in charge of digital signal processing at NCR's Microelectronics Division (Fort Collins, Colo.). He holds a Master of Science degree in electrical engineering from MIT and has worked for Bell Laboratories, as well as at Intel and IBM.

Dave Thomas has worked as a senior design engineer in the Microelectronics Division for two years. Previously, he designed circuits for Texas Instruments and the Naval Avionics Center. Thomas holds both master's and bachelor's degrees in electrical engineering from Purdue University.



Cover: Systolic array chip

the processor elements contains an ALU and 128 bits of RAM, as well as bidirectional communication lines that connect the cell to its neighbors on the north, south, east, and west. In addition, a separate I/O communication bus allows data to be input from the south end of the array and output to the north without interfering with computation within the ALU.

Central to the IC's makeup is its single-instruction, multiple-data architecture, which distributes processing power among each of the identical bit-serial processor elements. Further boosting speed in a large number of applications is the ability to cascade a number of ICs to form large arrays.

Interestingly, the processor elements themselves are not particularly fast, taking $2.5\ \mu\text{s}$ to add two 8-bit numbers. Executing 72 such operations simultaneously, though, yields an overall data rate of 28 million additions per second for each device.

Assembling an array of chips also eliminates the bandwidth limitations that plague von Neumann machines. For instance, a 48-by-48-cell systolic processor—comprising 32 chips—can

grab a 48-bit-wide word every 100 ns when operating with a 10-MHz clock. The array's bandwidth thus equals 480 Mbits/s.

In pattern recognition and automated inspection, the chip's ability to handle entire images concurrently, instead of one pixel at a time, as is traditionally done, greatly speeds throughput. Since images are taken care of by a single chip, interactions with the host are eliminated, as are the inherent restrictions of memory transfers using the system bus. And because a single cell can be mapped for each pixel in an image, adding more chips pushes speed even higher.

A juggling act

The systolic array also is particularly suited to digital signal processing. Unlike single-instruction, single-data computers which cannot simultaneously calculate a host of basic operations (like multiplication, convolution, and trigonometric functions), the chip can perform several of these common signal-processing operations concurrently.

Additionally, to minimize the number of data

Systolic arrays: The heart of the matter

A systolic array is a regular arrangement of simple, identical processor elements that are connected to their nearest neighbors. The term "systole" was originally used to refer to the recurrent contractions of the heart. As with the human circulatory system, systolic computations are characterized by the pumping of data through an array of processor elements. While data moves in and out of the processor element, some operation is performed on it during each cycle. This maintains a regular flow, or circulation, of data within the network. Although definitions vary, systolic processors must first of all run in sync with a global system clock, so that data is rhythmically computed and passed through the network.

An array can be extended arbitrarily by connecting two or more processor elements to increase speed linearly with the number of elements. A good

measure of the efficiency of an array processor vis-à-vis a single processor is the so-called speed-up factor, which is defined as the processing time for a single processor divided by that of an array.

The systolic architecture is a natural one; it is a subset of the cellular automaton—a uniform array of many identical cells in which each cell interacts only with its neighbors. Interestingly enough, it was the father of conventional computer architecture, von Neumann, who performed some of the earliest investigations into the cellular automaton structure as a potential machine configuration. Harbingers of today's systolic arrays are the Illiac IV system, developed in the late 1960s, and the massively parallel processor built by Goodyear Aerospace in 1981. Systolic chip architectures were developed at Carnegie-Mellon.

fetches normally required, reads to or writes from RAM can be performed on every cycle—at the same time as computations. That ability is significant in real-time processing and many number-crunching applications, which are by nature memory-intensive. It also lends itself to artificial intelligence, in which volumes of data requiring extensive parallel processing are the rule rather than the exception.

The chip operates at $5.0 \pm 0.5V$ and dissipates 500 mW at a 10-MHz clock rate. Data setup and hold times are 10 and 5 ns, respectively. Although 72 processors are now riding on the 100,000-mil² chip, future versions will go far beyond that. The 6-by-12 array is now fabricated with a 3- μm double-layer metal CMOS process, but shrinking line widths to 1 μm will crowd 512 cells onto an equal-sized chip. Clearly, such density makes CMOS the technology of necessity.

The array is housed either in a ceramic 84-lead pin-grid array or a plastic chip carrier (with the same number of contacts). As the number of processing elements is increased to 512, only 162 pins will be needed, not quite double the number now employed.

A peek inside

Each processor element contains separate lines that link the cell to its neighbors and to the outside world. In addition to the North South (N/S) and East West (E/W) lines that pass data between cells, are the CM South input (CMS) and CM North output (CMN) (Fig. 1). There is also a complement of 22 external signal lines: 7 address lines (A_0 through A_6), 13 control lines (C_0 through C_{12}), one global output (GO), and one clock (CLK).

The chip's overall simplicity is reflected in the layout of a single processor element (Fig. 2). Each of its four latches—CM, N/S, E/W, and C (referred to as the C register)—accepts data from up to eight possible sources, depending upon the setting of the control lines. C_0 and C_1 control the input to the CM latch; C_2 through C_4 govern the input to the N/S latch; C_5 through C_7 manage the input to the E/W latch; and C_8 through C_{10} , the input to the C register. Lines C_{11} and C_{12} handle reads to and writes from the 128-bit RAM.

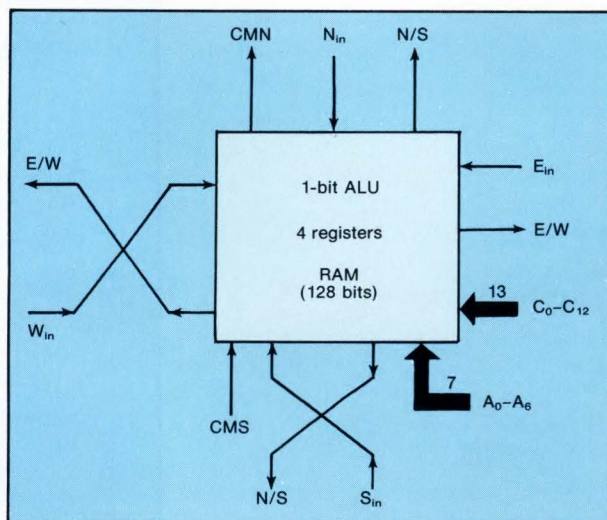
Working from a truth table, the array performs additions and subtractions (Table 1). The

C, NS, and EW inputs to the multiplexers represent the contents of the C, N/S, and E/W registers, respectively. The summing output of the single bit ALU, SM, goes directly to the RAM and may also be simultaneously input to any of the four registers. The Carry and Borrow outputs (CY and BW, respectively) are open to the C register. A truth table is used as well to fulfill single- and dual-input logic functions—logical complement, exclusive-OR, exclusive-NOR, logical AND, and logical OR—on data in the N/S and E/W latches (Table 2).

What are your instructions?

The chip is programmed with a sequence of instructions that, when compiled by an assembler, directs the appropriate control signals to every cell in the array. Up to five commands, one from each of the five groups that make up the overall set, can be executed simultaneously on every instruction cycle. The possible combinations of horizontally microcoded instructions results in nearly 6000 commands (see Table 3).

Images are manipulated by the array processor at a brisk pace. A 3-by-3-pixel mask with



1. Individual processor elements link to their next-door neighbors on the north, south, east, and west over bidirectional communication lines N/S and E/W, respectively. The control lines C_0 through C_{12} and address lines A_1 through A_6 establish the signal paths to the outside world. Each cell contains a 1-bit ALU, four registers, and a 128-bit RAM.

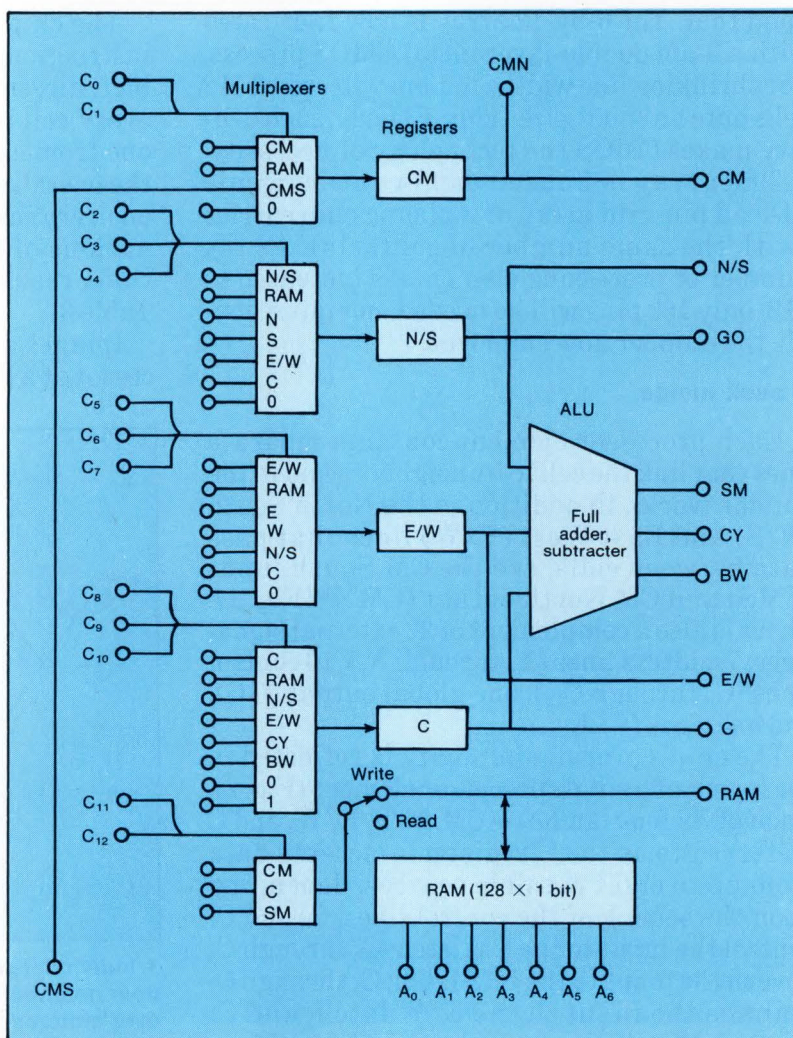
Cover: Systolic array chip

an 8-bit gray scale can be convolved with an 8-bit gray-scale image in less than 300 μ s, using what is termed a global broadcast operation. In that mode, a single bit (1 or 0) is transmitted to the C register of every processor in the array (by toggling control line C_8). Each processor will perform the same function on the broadcast data, thereby increasing throughput. Since mask data can be broadcast globally, every pixel in the mask can operate simultaneously on the entire image. Thus, the 3-by-3 convolution can be accomplished with nine sets of global operations that include multiply, shift, and add.

Similarly, a 9-by-9-pixel mask with an 8-bit gray-scale image can be convolved with an 8-bit gray-scale image in less than 5 ms. The 8 bits of gray scale furnish up to 256 shading intensities (from black to white)—better than the video signals coming from most TV cameras.

To the north!

As mentioned, the processor's speed can be enhanced by linking several chips to create larger arrays. Moreover, doing so does not require any changes in software. In addition, the systolic array has a Data Communication line



2. The layout of a single processor cell mirrors the simplicity of the overall array design. Each of the four registers, CM, N/S, E/W, and C, accepts data from up to eight sources. The settings of the control lines determine which information is sent to each register.

Exar... Innovation and Reliability For Surface-Mount ICs

Pick from Exar's family
of surface mount devices and reap the benefits,
lower assembly costs, smaller boards, higher performance...

Floppy Disk Read Amplifier — XR-3470A/XR-3470B — Performs the complete readback function, converts readback signal from magnetic head to a digital pulse. Features low peak shift and low input amplifier gain variation...from device to device.

Floppy Disk Write Amplifier — XR-2247/XR-2247A — Provides the complete interface function between write data signals and a tunnel-erase magnet head. Incorporates diode switching for read/write transfer, eliminating the need for external diodes.

Pulse-Width Modulating Regulator — XR-494/XR-495 — Provides the functions necessary to configure a pulse-width modulating regulator. Includes 5-volt regulator, error detectors, an oscillator, dead-time control comparator and necessary control circuits.

Monolithic Tone Decoder — XR-567 — A monolithic single chip phase-locked loop ideal for Touch-Tone® decoding, sequential tone decoding, communications paging, ultrasonic remote control and telemetry decoding.

Quad Line Driver/Receiver — XR-1488/XR-1489A — The Exar XR-1488 Quad Line Driver and 1489A Quad Line Receiver devices enable interfacing with data terminal TTL levels to RS-232C compatible systems. Both devices feature output current limiting.

Precision Waveform Generator — XR-8038/XR-8038A — The XR-8038 is a precision waveform generator in a single IC package. It produces sine, square, triangular, sawtooth and pulse waveforms with distortion of 0.5%, or less, and operates to 1 MHz.

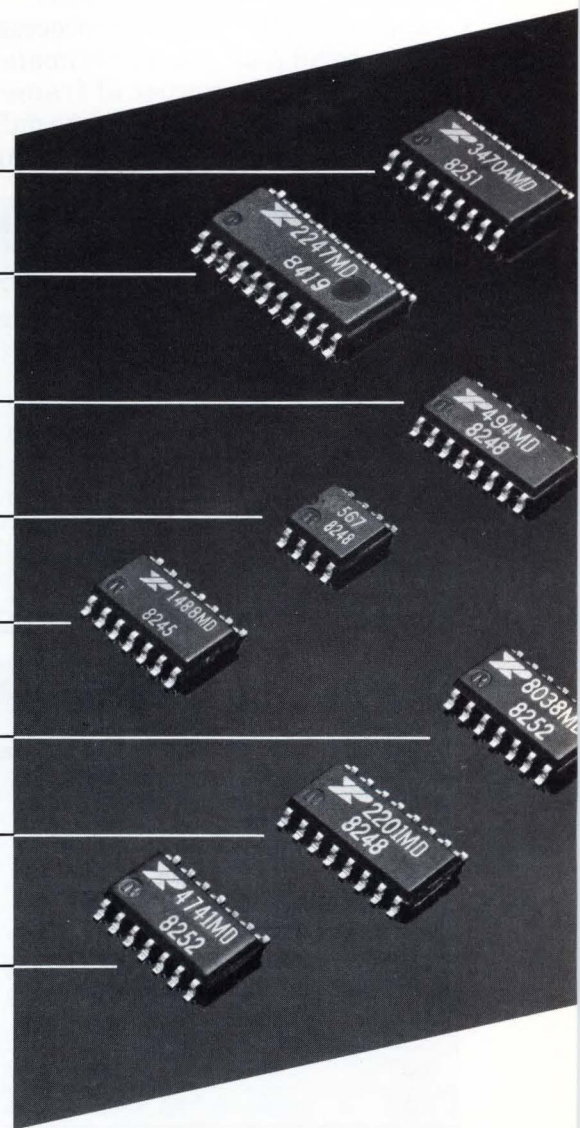
High-Voltage, High-Current Darlington Transistor Arrays — XR-2201, XR-2202, XR-2203, XR-2204 — Each IC comprises 7 NPN Darlington pairs. All feature open-collector outputs and protection diodes for driving inductive loads and other high-current drive applications.

Quad and Dual Operational Amplifiers — XR-4741/XR-3403; XR-4558 — XR-4741 is a quad op amp, similar to the popular 741 but superior in slew rate, bandwidth and noise level. It's fine for audio amplifiers and active filters.

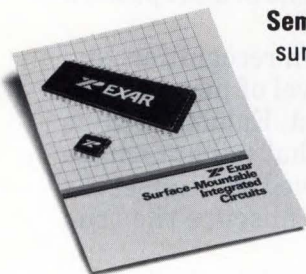
Semi-custom and Custom ICs — Exar can also supply surface-mount ICs in up to 40 pin packages for semi-custom and custom requirements.

Exar has the Answer! To order your free copy of Exar's Surface-Mounted Devices Brochure, write or call Exar.

"See Us At Electronica Booth 24C 106"



Exar Integrated Systems, Inc.
750 Palomar Avenue
Sunnyvale, CA 94086
408/732-7970
TWX 910-339-9233



Touch-Tone is a trademark of the American Telephone and Telegraph Company.

Cover: Systolic array chip

(CM)—a separate I/O bus that can accept data from the south, shift it to north, and send it out without interfering with ongoing computations.

A linear improvement in performance is seen as the number of processor elements increases. For example, if an operation on 1000 by 1000 pixels is handled by an array of approximately 250 by 250 cells, the image would be divided into 16 frames, each 250 by 250 pixels.

Increasing the number of processor elements by a factor of four—to approximately 500 by 500 cells—cuts the number of frames needed to compute the transformation to only four. Thus a fourfold increase in cells is accompanied by an

equal rise in processing speed. Consequently, users can tailor a system to satisfy the requirements of a specific application.

Because the array carries out traditional tasks like addition and multiplication, programming it is relatively straightforward. The algorithm for recognizing a 101 pattern demonstrates its ability to take care of both arithmetic and logical operations (Fig. 3).

Step by step

In the first step, the E/W registers of a configuration of 8 by 5 processor elements are loaded with the test pattern found at RAM location 0 of each cell. Next, the entire test pattern is shifted one column to the left. In the third step, that data is loaded into the N/S register and—simultaneously—the entire test pattern is shifted another column to the left into the EW register, and C is set to zero.

The N/S registers thus contain data that represents the pattern before the second column shift, and the EW registers contain data that represents the pattern after the second-column shift. The C registers next receive the results from the borrow outputs of the ALUs of each processor element. Also in the fourth step, the E/W register is reloaded with the original pattern. The Borrow outputs are equivalent to the logical expression:

$$BW = P_{M,N+1} \cdot P_{M,N+2}$$

where $P_{M,N+1}$ is a shifted-by-one version of the original pattern in cell row M, column N and $P_{M,N+2}$ is the shifted-by-two pattern. At the fifth step, the C register gets the Carry output that is logically equivalent to:

$$CY = P_{M,N} \cdot \overline{P_{M,N+1}} \cdot P_{M,N+2}$$

In the last step, RAM location 1 gets the final output. It is evident that only those processor elements that are at the left end of a 101 pattern will contain a 1.

A typical aspect of pattern recognition, and one that requires a high level of parallel processing, is edge enhancement. Enhancement is needed to overcome noise that might damage the quality of an image, as well as to offset the effects of dirt that might obscure the true boundary of the image.

The enhancement begins with a technique

Table 1. Arithmetic operations

Input			Output		
NS	EW	C	SM	CY	BW
0	0	0	0	0	0
0	1	0	1	0	1
1	0	0	1	0	0
1	1	0	0	1	0
0	0	1	1	0	1
0	1	1	0	1	1
1	0	1	0	1	0
1	1	1	1	1	1

Table 2. Logic operations

Logical operation	Output	Input	Input conditions
INV	SM = $\overline{NS}$ SM = $\overline{EW}$ SM = $\overline{C}$		EW = 0, C = 1 NS = 0, C = 1 NS = 0, EW = 1
AND	CY = $NS \cdot EW$ CY = $EW \cdot C$ BW = $\overline{NS} \cdot EW$		C = 0 NS = 0 C = 0
OR	CY = $NS + EW$ BW = $\overline{NS} + EW$ BW = $EW + C$		C = 1 C = 1 NS = 0
XOR	SM = $NS + EW$		C = 0
XOR	SM = $NS + EW$		C = 1

Speed readers.

With clock-to-output times as low as 15ns, our high-performance PROMs race through pages of microcode 30% faster than bipolar devices.

Which means simply plugging our pin-compatible 1Kx8 and 2Kx8 PROMs into existing designs dramatically increases performance.

But if you concentrate on speed alone, you're liable to miss some details.

Like the fact our PROMs not only read fast, they do it with less effort—half the power of bipolar PROMs.

Or the way you can order them with or without on-chip registers.

Then, of course, there's C²P.

You won't find it in the dictionary.

But you will find it in every Cypress Semiconductor PROM.

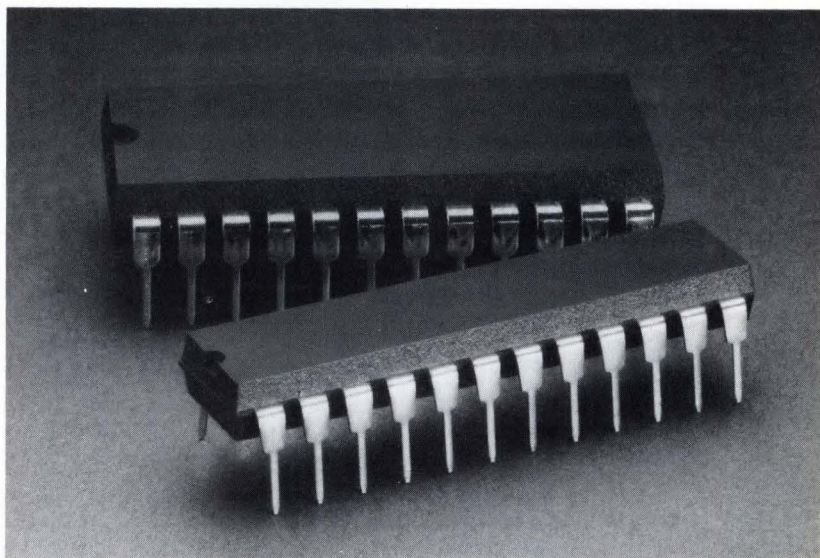
It's an innovative combination of our 1.2 micron CMOS process and proven floating-gate EPROM technology.

C²P cells make our speed/power ratio untouchable. And our reliability story one for the books.

For example, every high-performance PROM we ship is 100% write/read/retention tested.

Every PROM. Every cell. Every time.

And that's just one of hundreds of quality assurance steps programmed into our fully automated assembly and test facility.



The only one of its kind in the Silicon Valley.

All of which puts us in a perfect position to meet not only your quality standards but your production schedules, too—with an entirely unique kind of PROM.

One that reads 400,000 times faster than Evelyn Wood. And remembers every word.

For some interesting reading of your own, we'll send you details on our high-performance PROM family. And our equally impressive SRAMs. Just write Cypress Semiconductor, 3901 North First Street, San Jose, California 95134. Or telephone (408) 943-2668.



CYPRESS
SEMICONDUCTOR

The best time you can have with CMOS.

Cover: Systolic array chip

known as dilation: The image is shifted east, then an OR operation is performed with the original image. Then the image is shifted west and ORed, shifted north and ORed, and shifted south and ORed. This operation enlarges the width of all edges. Individual missing pixels are filled in to provide a continuous border. Larger gaps can be filled by shifting the image two or more units. To determine the true edge, the processor then erodes the image by shifting and performing an AND operation, effectively eliminating all the blocks it created during dilation except for those determined by the algorithm to be part of the actual image.

Since an exact match between the object being viewed and the image stored in memory is rare, convolution and correlation are necessary functions to determine how close the match ac-

tually is. In the simple 101 pattern given earlier, perfect matches are simple to demonstrate. In the longer strings found in real-world pattern recognition, convolution and correlation adjust for minor discrepancies.

Convolution and correlation

Convolution is employed in edge enhancement, for instance, to improve the quality of the image. It also calls on the array's ability to handle global broadcasts. In convolving a 3-by-3-pixel mask with an 8-bit gray scale, the mask is placed over every pixel in the image and the product terms in each 3-by-3-pixel window are summed.

Global broadcasting lets the system send a single portion of the 3-by-3-pixel mask to each of the cells within the array. To speed pro-

Table 3. Instruction set for the systolic array processor

Register operation	Mnemonic	C ₁₂	C ₁₁	C ₁₀	C ₉	C ₈	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀	Description
CM	CM: = CM	X	X	X	X	X	X	X	X	X	X	X	0	0	Micro NOP
	CM: = RAM	X	X	X	X	X	X	X	X	X	X	X	0	1	Load CM from RAM
	CM: = CMS	X	X	X	X	X	X	X	X	X	X	X	1	0	Move from CMS into CM
	CM: = 0	X	X	X	X	X	X	X	X	X	X	X	1	1	Load zero into CM
NS	NS: = NS	X	X	X	X	X	X	X	X	0	0	0	X	X	Micro NOP
	NS: = RAM	X	X	X	X	X	X	X	X	0	0	1	X	X	Load NS from RAM
	NS: = N	X	X	X	X	X	X	X	X	0	1	0	X	X	Move from N into NS
	NS: = S	X	X	X	X	X	X	X	X	0	1	1	X	X	Move from S into NS
	NS: = EW	X	X	X	X	X	X	X	X	1	0	0	X	X	Move from EW into NS
	NS: = C	X	X	X	X	X	X	X	X	1	0	1	X	X	Move from C into NS
	NS: = 0	X	X	X	X	X	X	X	X	1	1	X	X	X	Load 0 into NS
EW	EW: = EW	X	X	X	X	X	0	0	0	X	X	X	X	X	Micro NOP
	EW: = RAM	X	X	X	X	X	0	0	1	X	X	X	X	X	Load EW from RAM
	EW: = E	X	X	X	X	X	0	1	0	X	X	X	X	X	Move from E into EW
	EW: = W	X	X	X	X	X	0	1	1	X	X	X	X	X	Move from W into EW
	EW: = NS	X	X	X	X	X	1	0	0	X	X	X	X	X	Move from NS into EW
	EW: = C	X	X	X	X	X	1	0	1	X	X	X	X	X	Move from C into EW
	EW: = 0	X	X	X	X	X	1	1	X	X	X	X	X	X	Load 0 into EW
C	C: = C	X	X	0	0	0	X	X	X	X	X	X	X	X	Micro NOP
	C: = RAM	X	X	0	0	1	X	X	X	X	X	X	X	X	Load C from RAM
	C: = NS	X	X	0	1	0	X	X	X	X	X	X	X	X	Move from NS into C
	C: = EW	X	X	0	1	1	X	X	X	X	X	X	X	X	Move from EW into C
	C: = Carry	X	X	1	0	0	X	X	X	X	X	X	X	X	Load C from Carry
	C: = Borrow	X	X	1	0	1	X	X	X	X	X	X	X	X	Load C from Borrow
	C: = 0	X	X	1	1	0	X	X	X	X	X	X	X	X	Load 0 into C
	C: = 1	X	X	1	1	1	X	X	X	X	X	X	X	X	Load 1 into C
RAM	Read	0	0	X	X	X	X	X	X	X	X	X	X	X	Read from RAM
	RAM: = CM	0	1	X	X	X	X	X	X	X	X	X	X	X	Load RAM from CM
	RAM: = C	1	0	X	X	X	X	X	X	X	X	X	X	X	Load RAM from C
	RAM: = Plus	1	1	X	X	X	X	X	X	X	X	X	X	X	Load RAM from Sum

VF Technology... The Bright Decision

Futaba offers three display formats, so you can choose the best suited to your individual graphic/alphanumeric needs.

GRAPHICS DISPLAYS

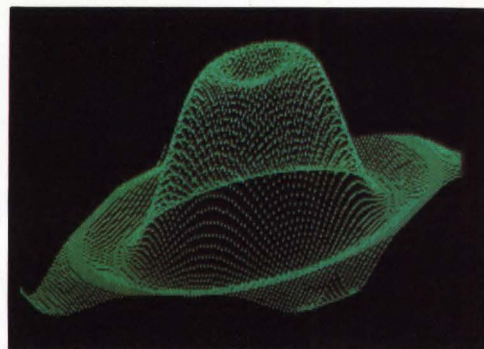
With the introduction of a graphics front luminous vacuum fluorescent display, (G-FLVFD), Futaba has extended the technology for flat panel displays. Designers will find the range of applications for this type of display extend far beyond the limits of an all-too-delicate CRT.

Front luminous capability offers a wider viewing angle plus superior readability under ambient light conditions. An innovative dual wire scanning system permits straight lines, arcs, curves and even three-dimensional graphics to appear cleaner and sharper. The precise requirements of medical, industrial process control instrumentation, or TV imagery are easily matched.

DOT MATRIX/ALPHANUMERIC DISPLAYS

Futaba offers a wide assortment of dot matrix and 14- or 16-segment alphanumeric displays. This variety allows you to choose the display best visually and economically suited to your applications.

From one to eighty digits, 14-segment to 5 x 12 dot characters, Futaba has the alphanumeric display for your application.



Compact flat panel graphics display presents clean, sharp images



A variety of gradations, controlled by the pulse width of the anode signal, permit TV imagery



Eighty 5 x 7 dot characters plus cursor provide user pattern flexibility and pleasing appearance



16-segment alphanumeric display offers economical word and numeric functions

GRAPHICS DISPLAYS

Number of Pixels row x column	Pixel Pitch mm	Effective Display Area mm	System	Electrical Characteristics						
				E_f (V)	I_f (mA)	e_b (Vp-p)	e_c (Vp-p)	E_k (Vdc)	Duty Cycle	L (ft-L)
128 x 64	0.65	83 x 41.4	VFD	4.1	300	100	75	8	1/80	400
128 x 128	0.40	84 x 50.8	VFD	2.7	375	120	75	10	1/160	400
256 x 64	0.65	166 x 41.4	VFD	7.5	300	100	70	10	1/160	200
320 x 120	0.375	120 x 45	FLVFD	2.5	910	100	80	5	1/152	100
320 x 240	0.375	120 x 90	FLVFD	4.5	910	120	90	5	1/303	100

DOT MATRIX/ALPHANUMERIC DISPLAYS

Type Number	No. of Digits	Characters Pattern	Character Dimensions		Outer Dimensions		Electrical Characteristics						Notes
			C.H.	C.W.	P.L.	P.H.	E _f (V)	I _f (mA)	e _b ·e _c (Vp-p) Eb-Ec (Vdc)	Ek (Vdc)	Duty Cycle	L (ft-L)	
16-SD-01Z	16		5.0	3.5	96.9	20.5	4.9	22	25	5.0	1/20	200	5 x 7 Dot Character
32-SD-43Z	32		8.75	3.5	205.2	33.5	7.3	100	29.5	8.5	1/40	200	5 x 12 Dot Character
402-SD-04Z	40 x 2		5.0	3.5	220.2	40.0	7.8	150	31	9.0	1/50	180	5 x 7 Dot Character Cursor
8-SY-01Z	8		5.0	3.0	64.7	20.5	3.3	18	19	4.0	1/12.5	200	14 Segment
16-LY-01ZL	16		12.5	7.0	205.2	33.5	7.2	75	47	10	1/20	200	16 Segment
32-SY-03ZL	32		5.0	3.0	205.2	24.8	7.5	50	35	10	1/40	200	14 Segment



FUTABA
Corporation of America
Electronic Components Division

For more information on graphic or alphanumeric displays, call or write today.

711 E. State Parkway, Schaumburg, IL 60195
Telephone: (312) 884-1444 Telex: 206-833

Cover: Systolic array chip

cessing, the parts that make up an image plane can be shifted to the center of the convolution window before the required multiplication is performed. That increases efficiency because two 8-bit integers form a 16-bit product. If the shift were not carried out first, the product would have to be shifted bit-serially to the center of the window.

At the end of the convolution, the chip will have performed a total of nine global 8-bit multiplications, twelve shifts, and nine 16-bit additions. The approximate execution time for each multiplication is 25.2 μ s; for a shift, 2.4 μ s; and for addition, 4.9 μ s. Thus a total of just 299.7 μ s is expended on the operation.

A binary correlation mask using a binary image is conceptually identical to convolution, but bit-wide exclusive-OR operations are worked with instead of multiplications. The correlation creates a level of comparison, so that a decision threshold can be established to determine whether a match is close enough to meet system requirements. A score of 441 denotes a perfect match; 0 indicates an inverse image. Thresh-

olds can be set at any level in between to determine pass or fail.

Processing a 21-by-21-pixel binary correlation mask takes one exclusive-OR, 1536 shift operations, and 400 additions. The exclusive-OR and shift operations take 300-ns apiece, and additions take 1.6 μ s. Total execution time is thus 1.3 ms.

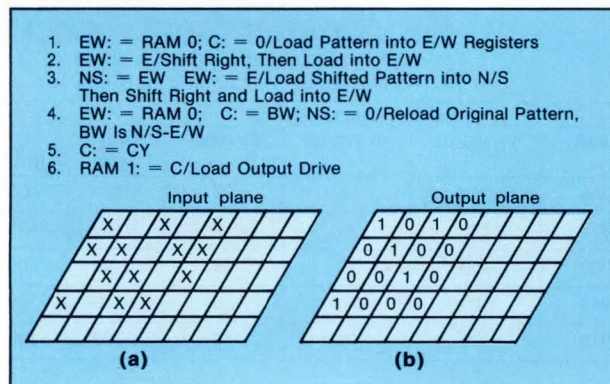
Moving pictures

In an image-processing system, a series of chips can be combined to perform various functions. For example, a Multibus-based setup can be built around an arrangement of 48-by-48-processor cells that store and manipulate image data (Fig. 4). Incoming video data is temporarily stored in a row of eight GAPP devices that serve as a line buffer. After an 8-bit analog-to-digital converter processes the image, the corner-turning row, as it is called, accepts an 8-bit gray scale value for each pixel.

While the camera is horizontally retracing, the video data is shifted from the buffer into the processing array. The first step of this shift is the corner-turning operation, which is performed by switching data from the EW latch into the CM latch of the line buffer. As each pixel's 8 bits are clocked out of the video line buffer, they are transferred into the bottom row of processing elements, where they are stored in the internal RAM at addresses 0 through 7. At the same time, the previous video line is shifted up one row. The entire operation requires 18 instructions, well within the array's speed limitations. Operating at a 10-MHz clock, the chip can execute as many as 120 instructions in the 12- μ s horizontal retrace period of a typical camera. Once the entire video frame has been loaded into the array, computations can be performed.

The end result of these computations is a processed video frame that is held in the internal RAM of the cascaded arrays. Data can be sent from the arrays using the same instructions that were followed to load it.

A feature that significantly increases throughput is the ability to transmit data and load in a new frame concurrently. For instance, if frames A and B are loaded into the array, the resultant frame, A', is being computed while a third frame, C, is being loaded. Similarly, as A'



3. A simple six-step algorithm allows the array processor chip to recognize a 101 pattern. When the chip accepts an "X blank X" (or 101) pattern from a camera (a), it indicates a match by putting a 1 in the output plane (b). Every 1 in the output plane indicates the first X of the pattern.

RSD—THE DISK DRIVE WITH REMOVABLE MEDIA GIVES YOUR CUSTOMERS A SENSE OF SECURITY.

TOLL FREE
HOTLINE

1-800-828-8001

EXT. 82

IN MINNESOTA
(612) 921-4400



REMOVABLE DATA PACK

80 megabyte data packs provide backup for fixed disk, secure storage for vital data and portability for programs and data.

BUILT-IN RELIABILITY with proven technology including LSI circuitry and a micro-processor for servo control.

HALF-RACK™ SIZE, but the same capacity, speed and performance as the CDC® Storage Module Drive (SMD) in a unit half the size.

T H E R S D

The model 9710-80 disk drive is rapidly becoming a standard in removable data storage. Not only because it's a companion to our very successful FSD but because systems often need the advantages of removable media.

For information call your local Control Data OEM sales representative; call the toll-free number shown above or write: OEM Product Sales, HQW08X, Control Data Corporation, P.O. Box 0, Minneapolis, MN 55440. Also available through your Arrow or Kierulff Distributor.



CD CONTROL DATA

Cover: Systolic array chip

is being sent, the next frame can be loaded. In this case, once three frames are loaded, real-time pipelined processing is obtained. The set of three 16-bit latches multiplexed onto the Multibus board also lets the host exchange data with the system. Finally, information can also be delivered to the line buffer and sent to a video monitor using a d-a converter.

The implementation of a control store lets the arrays receive a set of instructions from the host and store them, freeing the host for other tasks. The store operates in conjunction with a sequencer that watches for and maintains the correct sequence as the arrays perform their instructions.

A system such as this can also be implemented as a workstation for developing software meant for the processor chip. An

upcoming software simulator and assembler, running in conjunction with the workstation, will allow users to load input data into a group of arrays, run through a sequence of instructions, and transmit the results back to the host computer. Additionally, a software library of macrocells will form the basis of a high-level command set for the processor. □

Acknowledgment

The Geometric Arithmetic Parallel Processor was developed in conjunction with Martin Marietta Aerospace Corp. for use in real-time target recognition.

How useful?**Circle**

Immediate design application

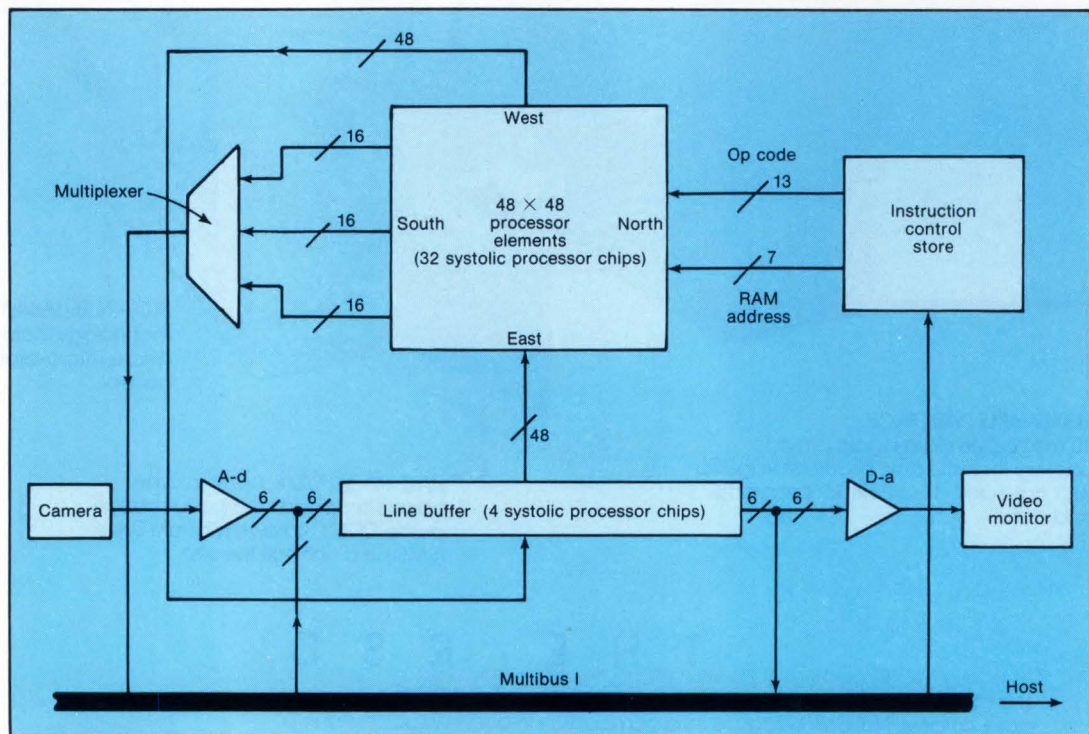
541

Within the next year

542

Not applicable

543



4. A single-board system can be built around two blocks of array processor chips. One block serves as the processing unit; the second, as the line buffer. The control store retains the commands from the host, freeing it to carry out other tasks.



When you say "Data Display"... You've said the last word on packaged LEDs.

"Application support"
"Design integrity"
"High performance"
"Competitive prices"
"Lifetime guarantee"

You've said all that and more when you simply say "Data Display." It's the last word in packaged LEDs.

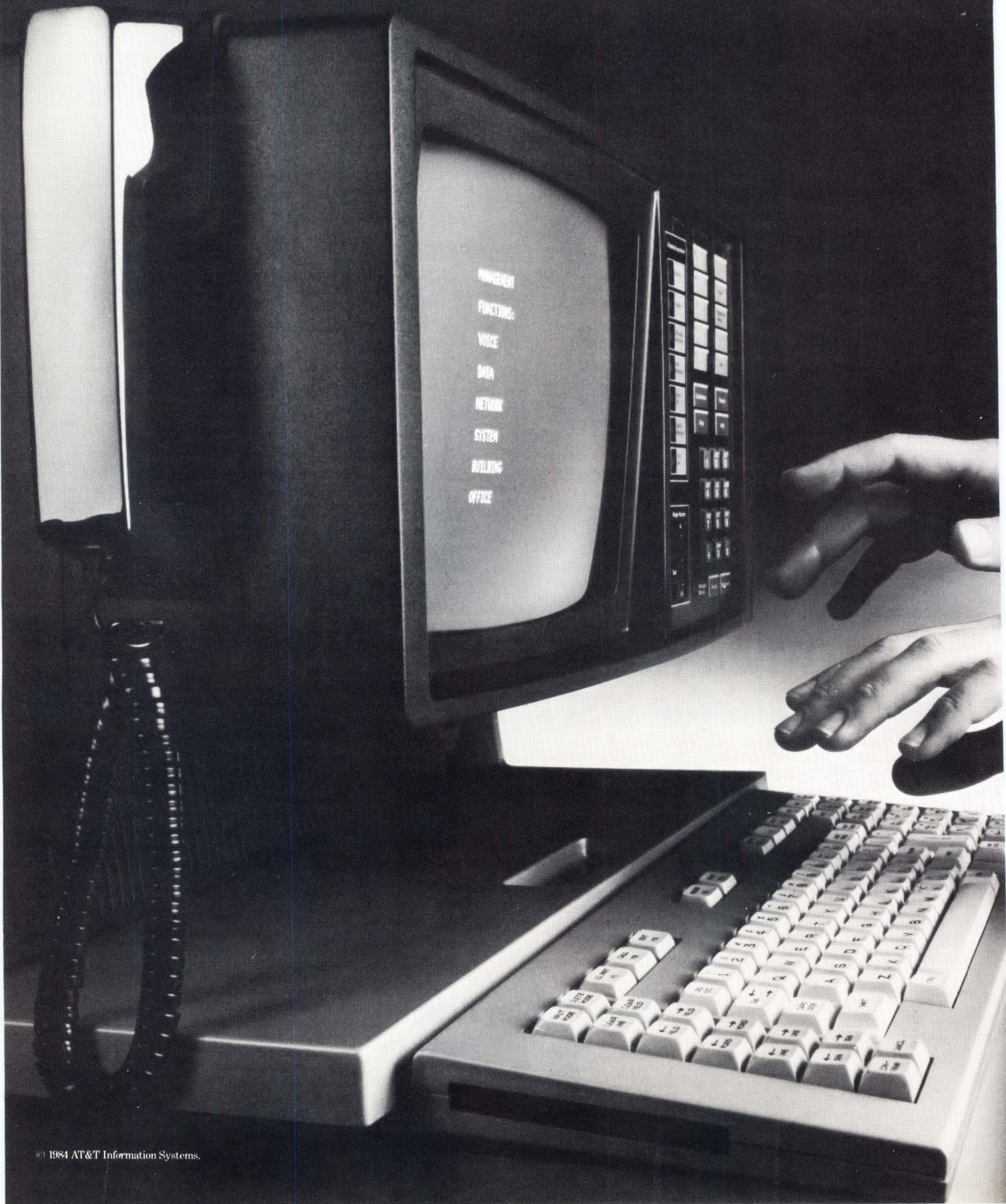
Call us today. Toll free (800) 421-6815. Within California, call (213) 640-0442. Or TLX 664-690. Or write us: Data Display Products, P. O. Box 91072, Los Angeles, California 90009.

International Reps — Argentina YEL S.R.O., PH: 46 2211, TLX: 390 18605, YELAR • Australia Ampec, PH: 02 818116, TLX: 790 27136 AMPEC • Belgium/Holland Klaasing Etc, PH: 01620 51400, TLX: 844 54598 KLBDNL • Denmark Radio Parts, PH: 01 34 34 11, TLX: 855 19613 RPARTDK • Israel R.C.M. Computers, PH: 03 485192, TLX 922 341390 • Italy Microdata, PH: 0187 988182 • South Africa Liberty Elec., PH: 52 7637/8/9, TLX: 960 86732SA • Spain, Betatron, PH: 6932421, TLX: 23911 PCOE • United Kingdom Marl Int'l, PH: 0229 52430, TLX: 851 65100 MARLG • West Germany/Austria Kuhn, PH: 06235 5662, TLX: 841 464766 KUHND •

Data Display Products



AT&T SYSTEM 85 AND AT&T SYSTEM 75 YOUR COMPANY PERFORM IN SIX-PART



CAN HELP HARMONY.



In the office, in the factory—the pressure to perform has never been greater. With ever increasing competition straining profits, companies must find new ways to control the cost of doing business.

A communications and information management system whose parts are in tune and working together can make a real difference in the bottom line.

AT&T System 85 and AT&T System 75 from AT&T Information Systems are the digital systems that fully integrate six vital information management functions—voice, data, office, building, network and system management—into a single harmonious system. Systems that not only deliver information to you economically, but also grow and adapt over time with minimum disruption to business.

These integrated systems can help increase productivity without compromising quality. They also can help manage costs.

VOICE & DATA MANAGEMENT These systems allow simultaneous voice and data transmission so you can reduce delays in accessing information.

OFFICE MANAGEMENT System 85 and System 75 can reduce overhead by helping to handle day-to-day administrative work with lightning speed.

For instance, Electronic Document Communication helps create and update documents such as status reports, maintenance and repair orders, and quality control reports. And these can be transmitted immediately to the plant or branch offices or stored for easy reference.

Message Center provides a central-

ized location, where attendants give and receive information, ensuring that no phone is unanswered.

BUILDING MANAGEMENT These systems automatically control and monitor energy consumption and security in your office and plant. Considering the rising cost of energy—and the rising rate of crime—those are things you can't afford to ignore. Also, these sensor-based systems can detect dangerous building conditions such as fire or flooding, protecting life and property.

NETWORK MANAGEMENT System 85 and System 75 enable you to link your plant and offices—across town or across the country—into a single communications network. All the parts of your operation, no matter how physically separate, can function as smoothly as if they were under one roof.

SYSTEM MANAGEMENT System 85 and System 75 put you in control of your own system. They allow you to administer and adapt hardware and software to your specific needs, and enable you to reduce and control costs of telephone moves and changes. Site communication managers will also be able to monitor and help eliminate unauthorized toll calls.

These systems incorporate Information Systems Architecture, the framework that ties our products together and provides for future expansion and system integration.

OVER 100 YEARS OF BETTER COMMUNICATION

For over a century, AT&T products and systems have set the standards for performance and reliability.

Today, more than 4,000 systems designers and others formerly at AT&T Bell Laboratories are working exclusively to develop new business products at AT&T Information Systems Laboratories. And, as always, we back our products with the most experienced sales and service force in the industry.

They're there to see that System 85 and System 75 help your business perform the way it ought to perform. In perfect harmony.

For more information, call 1-800-247-1212, Ext. 191.

**AT&T INFORMATION SYSTEMS.
WHEN YOU'VE GOT TO BE RIGHT.**



AT&T

Information Systems

Announcing the arrival of the world's first universal

Standard Microsystems' HDC 9224 is so advanced it controls hard disks, floppy disks and even tape back-up.

The new addition to Standard Microsystems' magnetic controller family is a single chip that controls Seagate-compatible hard disks, as well as IBM®-compatible single- and double-density floppy disks.

A single chip that allows you—for the first time—to include tape

back-up in a small computer without adding a lot of costly hardware and software.

A single chip so advanced its built-in DMA controller and ECC detect and correct errors with absolutely no processor intervention.

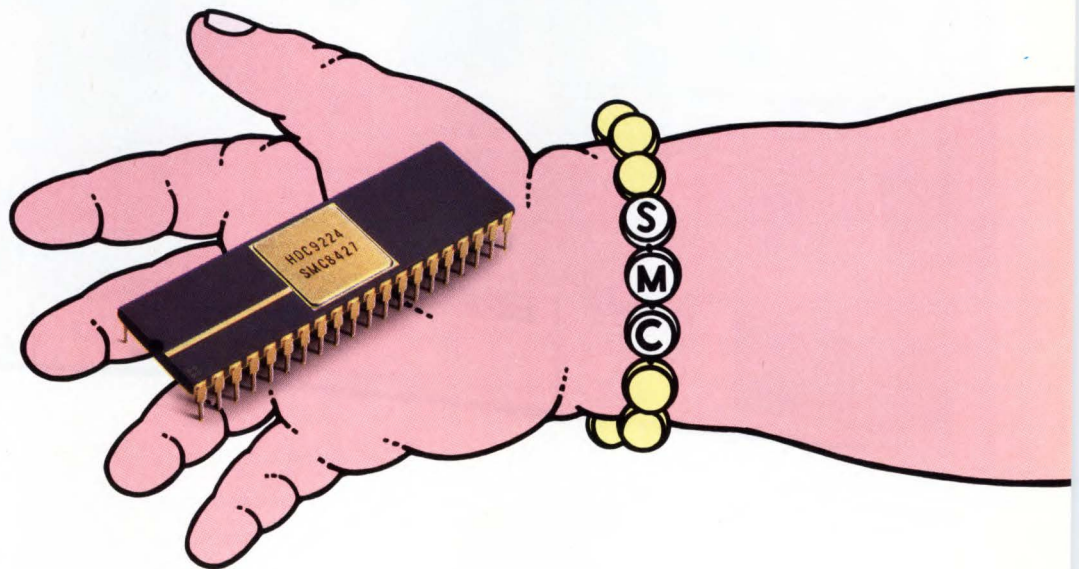
We've named this new addition the HDC 9224 Universal Disk Controller. But, you may call it one of the biggest breakthroughs in IC performance in a long, long time.

The cornerstone of an intelligent subsystem.

The HDC 9224's ultraflexible architecture makes it the true "next generation Winchester disk controller." With the addition of a few simple parts, you can use the HDC 9224 to build a high-performance, low-cost subsystem that not only controls hard and floppy disks, but cartridge or cassette back-up, too.

The HDC 9224 easily interfaces to all popular ST506-

disk controller.



compatible hard disk drives with up to 16 heads. Its flexible format command lets you select hard disk sector lengths up to 16 kilobytes and can be used with both interleaved and non-interleaved sector formats.

What's more, the HDC 9224 controls up to four disk drives of all sizes—8-inch, 5.25-inch and the new 3.5-inch—and it can read and write a wide variety of single- and double-density floppy formats, including such standards

as IBM's 3740 and System 34.

Available for immediate delivery.

Best of all, you can get the HDC 9224 when you need it the most. Today. We also plan to announce a well-respected second-source in the near-term future.

The HDC 9224 Universal Disk Controller is an n-channel, silicon-gate MOS/VLSI circuit fabricated with Standard Microsystems' COPLAMOS® technol-

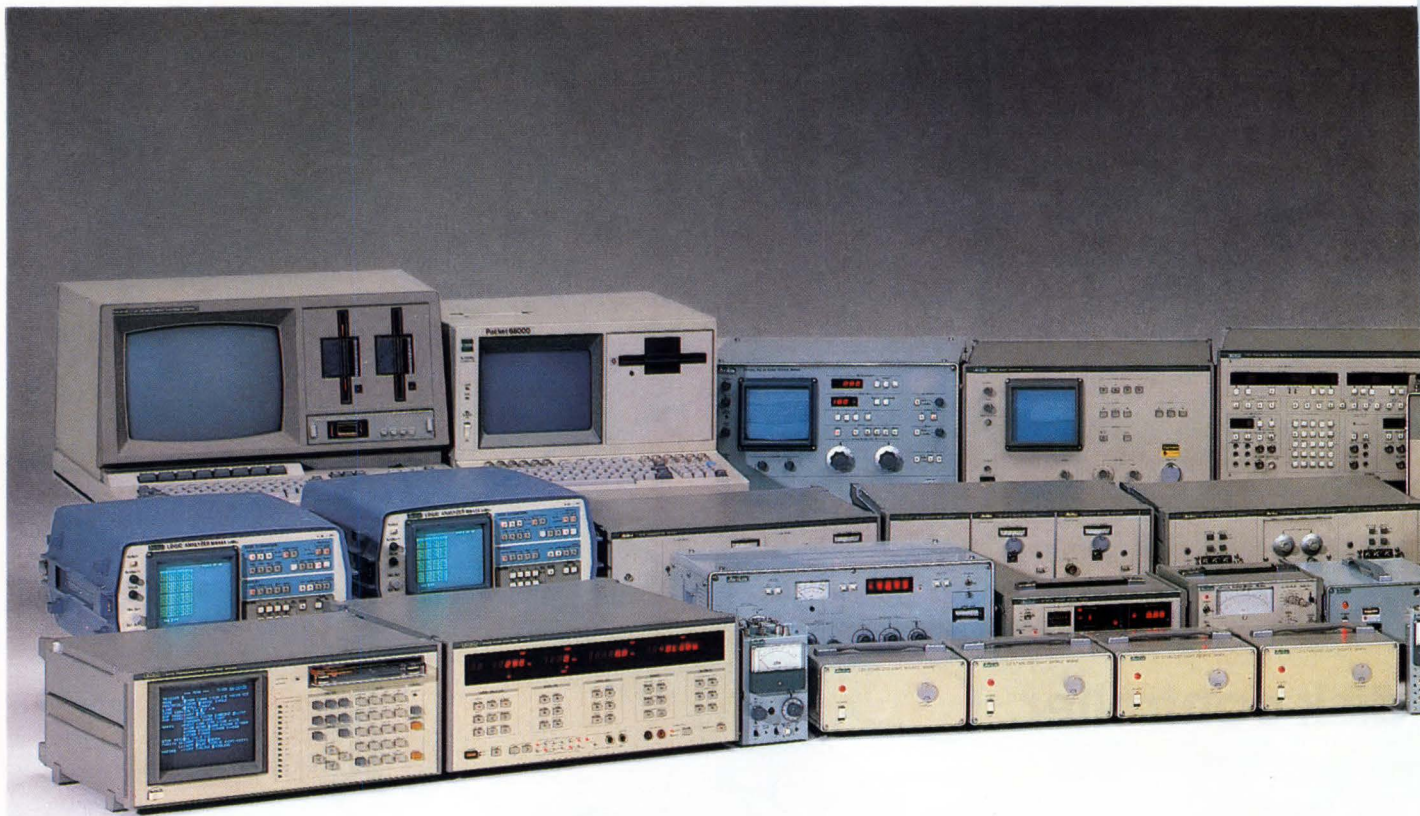
ogy. It's available for immediate delivery in a 40-pin ceramic or cerdip dual in-line package.

For more information, contact Standard Microsystems Corporation, 35 Marcus Blvd., Hauppauge, New York 11788. (516) 273-3100.

IBM® is a registered trademark of the International Business Machine Corporation.

STANDARD MICROSYSTEMS CORPORATION

Better Instruments for Better Communications



The MS710A Spectrum Analyzer

Covers 10MHz to 23GHz, with an amplitude range from -115 all the way to $+30\text{dBm}$. Search functions locate the desired signal fast. Internal tracking preselector keeps distortion way down. And easy-to-read CRT display has alphanumeric labels for all important information. Another professional instrument from Anritsu.



Anritsu means communications.

We began building telephone and radio equipment more than 50 years ago. And although we've expanded into other fields since then, we've remained true to those first electronic roots.

In fact, the Anritsu name is now known around the world as synonymous with communications. From public telephones to sophisticated, state-of-the-art



optical and digital transmission systems, Anritsu communications products are highly regarded for both unequalled reliability and technical excellence.

With such wide-ranging experience in all phases of communications, it's no surprise that our electronic measuring instruments are superior, too.

Anritsu builds the electronic instruments that keep electronic

and fiber optic communications operating at the knife edge of efficiency. From the simple measurement of voltage and current to complete high-level analysis of both analog and digital circuitry, Anritsu instruments are built by experts in communications. And Anritsu instruments are built to be used.

Whether it's an Anritsu electronic voltmeter, a network ana-

lyzer or a complete GPIB-based automatic test system, you'll find a basic field-proven ruggedness built in. And you'll find controls that actually make sophisticated measurements simpler to perform.

At Anritsu, we're striving toward still better instruments. And better communications.

ANRITSU ELETRÔNICA COMÉRCIO LTDA.

Av. Passos, 91-Sobrelôjas 204/205-Centro, 20.051-Rio de Janeiro-RJ, Brasil Phone: 221-6086, 224-9448 Telex: 2131704 ANBR

ANRITSU AMERICA, INC.

128 Bauer Drive, Oakland, NJ 07436, U.S.A. Phone: 201 337-1111 Telex: 642-141 ANRITSU OKLD

ANRITSU EUROPE LIMITED

Thistle Road, Windmill Trading Estate, Luton, Beds, LU1 3XJ, U.K. Phone: (STD0582)418853 Telex: 826750 ANRSEU G

ANRITSU ELEKTRONIK GmbH

Uhlandstrasse 9, 4000 Düsseldorf 1, F.R. Germany Phone: (0211)682424 Telex: 8584904

Anritsu
CIRCLE 102
ANRITSU ELECTRIC CO., LTD.
10-27, Minamiazabu 5 chome, Minato-ku, Tokyo 106, Japan
Phone (03) 446-1111/Telex: 0-242-2353
Cable: ANRITDENKI TOKYO

When you need fast, easy selection of magnetic cores for switching power supplies,

Only Magnetics Offers the Full Range				
Common Mode Filter	In Line Filter	Driver	Output Transformer	Power Filter Inductor
Ferrite toroids Ferrite shapes (ungapped)	Molypermalloy powder cores 50 Ni-50 Fe powder cores Gapped ferrites	Bobbin cores Ni-Fe tape wound cores Ferrite toroids	Ferrites (a) pot cores (b) shapes (c) toroids Ni-Fe tape wound cores Amorphous tape wound cores Cut cores (a) Ni-Fe (b) Amorphous (c) Ni-Fe laminations	Molypermalloy powder cores 50 Ni-50 Fe powder cores Gapped ferrites Cut cores

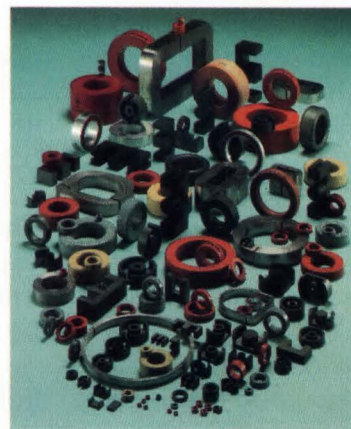
We deliver the widest
product choice – useful design data –
the best application engineering –
all from a single source: **MAGNETICS.**

It's a jungle out there in the switched mode power supply and regulator design world. Higher frequencies. Smaller sizes. Greater efficiencies. Better semiconductors. And choices, choices, choices in magnetic core materials and geometrics.

You know the impact the proper choice of core material will have on your power supply cost and performance. There's only **one house** that can provide you with the full

range of your magnetic core needs – **and world class design data and application engineering to go with it – MAGNETICS.**

Let us show you. It will cost you nothing. Tell us the problem you face or describe your need. We'll provide you with core information, back it up with application engineering and supply sample cores if needed. Write: MAGNETICS, P.O. Box 391, Dept. ED-6, Butler, Pennsylvania 16001.



MAGNETICS. The Promise Keepers.



12-bit a-d converter slips smoothly into analog and digital realms

Running from just 5 V, a 12-bit analog-to-digital converter chip lowers system parts counts with its direct analog and microprocessor interfaces.

In a world succumbing rapidly to the spell of microprocessor chips, a high-resolution analog-to-digital converter chip should find many uses, new as well as old. That should prove even truer if the device incorporates features for the analog as well as the digital interface.

None of today's converter options for resolutions above 10 bits is satisfactory for large-volume applications. The only monolithic devices at hand are either slow integrating converters or ICs that require complex analog design support. Multichip hybrids are power-hungry, need at least two power supplies, and are often awkward to interface with microprocessors. For high-resolution conversion, in fact, modules and discrete designs are still much in use.

A CMOS 12-bit successive-approximation a-d converter chip rises to the occasion. (Actually, there are two converters, the ADC1205 and ADC1225, but apart from their output configuration they have the same design.) Likely applications for the chip range from the control of internal combustion engines and graphics di-

gitization through robotics and position sensing on to industrial monitoring and control systems in general.

The converter's design centers on a charge-balancing comparator, which is easy to implement in low-power CMOS. This unusual type of comparator is crucial to the chip's high resolution and also deserves most of the credit for the converter's versatile analog input. Furthermore, it makes use of differential inputs and determines input polarity.

Finally, the comparator can handle input signal voltages that span both power-supply rails. Indeed, the fact that the converter operates from one or at most two supplies might well be its most important asset to many users (ELECTRONIC DESIGN, Oct. 4, p. 291).

A straight arrow

The converter's input circuitry is clean yet flexible (Fig. 1). Differential inputs accept a signal range that includes both the plus and the minus supply rail (the chip is, in fact, a 12-bit-plus-sign, or 13-bit, converter). With a single 5-V supply, the V_{in}^+ and the V_{in}^- pins can each vary between 0 and +5 V; using +5-V supplies, the pins can vary between -5 and ± 5 V. The differential feature helps surmount many of the common-mode problems found in single-supply systems. Moreover, the chip's high input impedance eliminates the need for buffer amplifiers, provided the signal's source impedance

Leonard Sherman, National Semiconductor Corp.

Leonard Sherman graduated from MIT in 1975 with a BSEE and subsequently worked there at the instrumentation laboratory of the Nutrition and Food Science Department. He is now an MOS analog applications engineer at National Semiconductor in Santa Clara, Calif.

12-bit a-d converter

has a value of less than $1\text{ k}\Omega$.

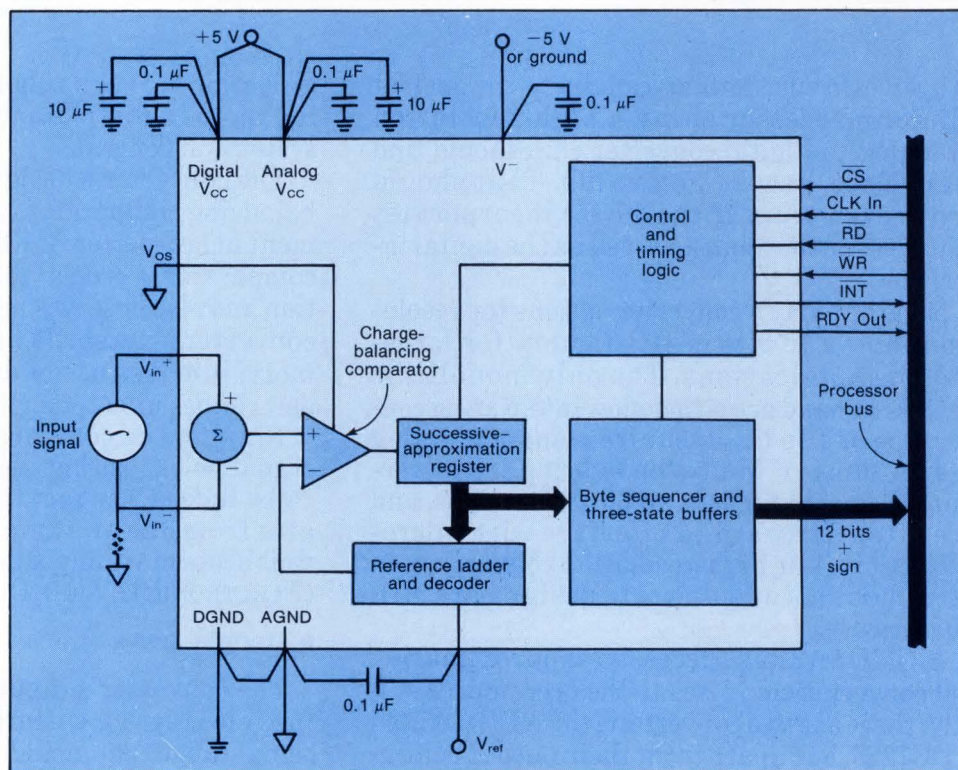
Whether working with a single or a split supply, the converter draws at most 6 mA, dissipating 30 or 60 mW, respectively. The digital and analog portions of the chip each have their own V_{CC} and ground pins. That arrangement makes it much easier to optimize power supply connections (for example, when trying to rid analog input circuitry of digitally generated clock or switching noise).

Input polarity

Since the converter has two power-supply choices, it accommodates unipolar or bipolar input voltages without external op amps or scaling resistors. That alone should please de-

signers who have been searching for an op amp that can run from one 5-V supply and that exhibits offset voltage and drift errors of less than 1 LSB at 12 bits. Also helping to reduce the parts count, a separate offset adjustment pin (V_{OS}) nulls or corrects signal offsets. It eliminates the current-summing techniques or additional op amps often found at the converter's input.

The analog reference connection (V_{ref}) is extremely simple, since the chip's design allows bipolar and positive or negative analog input voltages to be measured with only one positive reference. The converter's external reference input also makes it easy to implement ratio-metric measurements.



1. Because of its CMOS nature, the ADC1205/ADC1225 analog-to-digital converter uses an unconventional charge-balancing comparator and can run from one 5-V supply. The 12-bit chip handles differential input voltages, including power supply rails, and also generates a sign bit for bipolar inputs.

As for the digital interface, the basic Read, Write, and Chip Select lines connect the converter directly to most data buses. In addition, the Ready Out line simplifies the hardware connection to high-speed microprocessors, since it enables the a-d converter to insert a wait state in the processor's read cycle. Seldom does the digital interface need to be supplemented by any other devices.

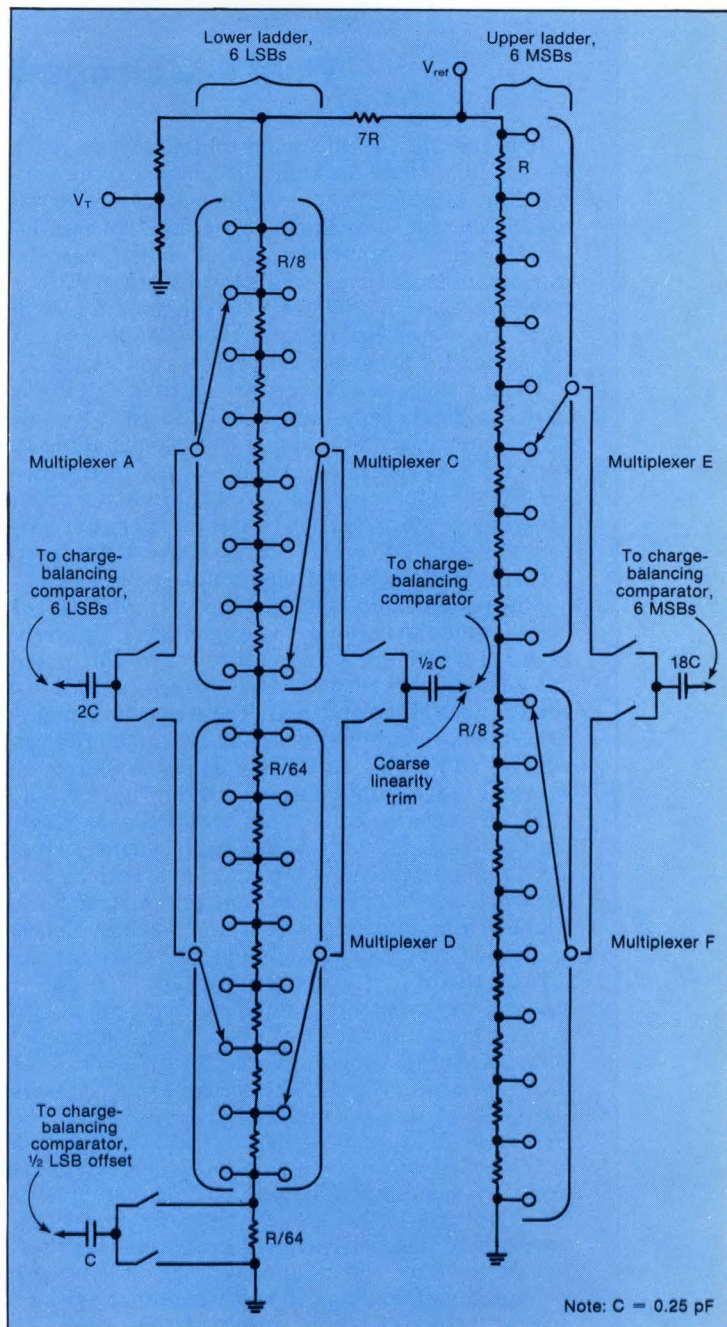
The two versions of the converter serve different microprocessor inputs. For 16-bit buses and stand-alone applications, the ADC1225 puts out 12 data bits and a separate sign bit, all in parallel. The ADC1205 serves 8-bit buses with a 2-byte output format, in which two successive read operations issue first the high byte and then the low byte. The 1205 also has the advantage of a smaller, 24-pin package, whereas the 1225 needs 28 pins. The conversion rate for both chips is 10 kHz.

Converters built around a successive-approximation register employ just one comparator for all bit tests, meaning that any error caused by that element could severely limit accuracy. The charge-balancing type of comparator works well in this setup because of its low offset and high gain (see "What is a Charge-Balancing Comparator?", p. 230). The 12-bit converter chip's comparator has, in addition, a clocked output and thus is not susceptible to jitter and oscillation—both problems that are often encountered in conventional analog comparators, which have been pushed hard for a-d converter applications.

Up and down the ladder

The converter's reference ladder adopts a novel arrangement that improves precision while accommodating high-volume production. Although the ladder's customary silicon-chromium resistors maximize temperature and long-term stability, they are not arranged in the standard R-2R configuration. Instead, the ladder is made of several serial sections, each holding resistors of equal value. Those sections are decoded by more than one multiplexer before feeding into differently weighted comparator inputs (Fig. 2).

The lower portion of the reference ladder not only determines the six least significant bits of the conversion but also corrects resistor trim



2. The dual reference ladder of the a-d converter serves several purposes. Besides handling conventional reference functions during conversions, it corrects offset and nonlinearity.

12-bit a-d converter

(text continued on p. 232)

What is a charge-balancing comparator?

In nearly all types of analog-to-digital converters, the key component for high performance is the comparator. Most of the converters place heavy demands on the comparator (or comparators, depending on the converter type). For instance, the component must have low offset voltage and little or no hysteresis. In addition, it must remain free of oscillation when looking at low-level signals yet at the same time make quick decisions about them.

Though those parameters are mutually exclusive in many conventional linear devices, they become harder to satisfy in a high-resolution system. In fact, CMOS processing cannot yet produce a conventional comparator that could operate in a 12-bit successive-approximation converter. For that reason, the ADC1205/ADC1225 a-d converter chip incorporates an unconventional comparator design.

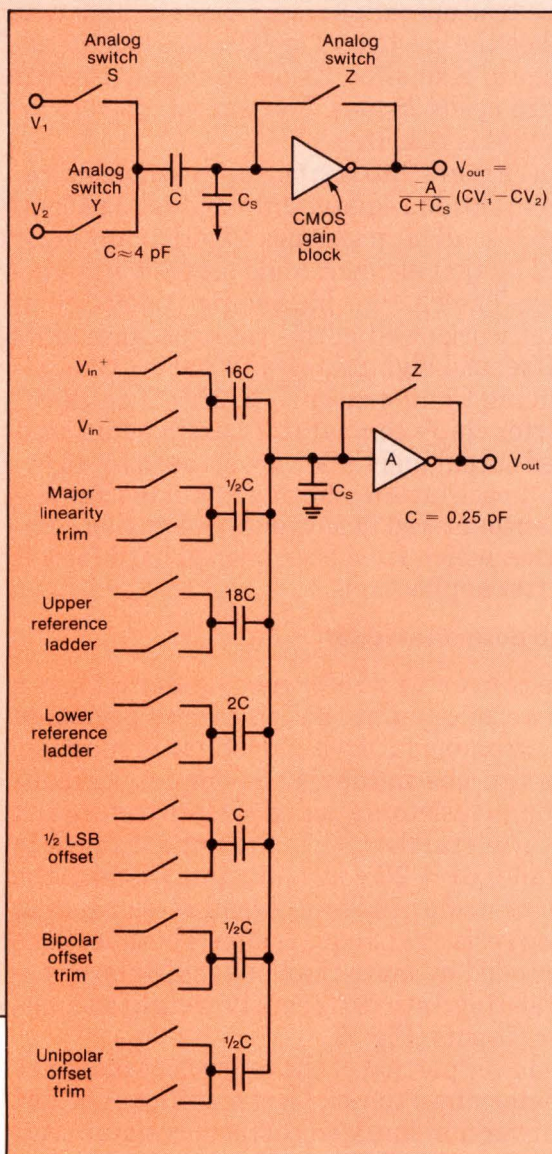
The design exploits gain stages with high input impedances and high-quality capacitors and switches, all of which are easy to fabricate in CMOS and can virtually overcome the technology's limitations, such as poor offset and drift. These circuit elements implement an automatic nulling technique to form what is commonly called a charge-balancing, or sampled-data, comparator (see the figure). The basic comparator consists of a CMOS gain block, similar to a logic inverter, shunted by analog switch Z. The gain block's input is connected to both capacitor C and switch Z. The other end of the capacitor is connected to analog inputs V_1 and V_2 through two additional analog switches, S and Y. The basic structure creates one differential input pair.

A charge-balancing comparison consists of two cycles. One automatically nulls the gain stage and samples the input voltage on the negative side of the differential input pair. The second cycle connects the positive input and makes the comparison. In the first cycle, the Y input switch and the Z shunt switch are closed. Meanwhile, capacitor C is charged to the negative input, minus the gain block's input bias, or offset, voltage. In the second cycle those two switches open, and the positive input is connected via the S switch. In effect, the input capacitor now subtracts its stored voltage from the positive input voltage, and the difference is amplified by the gain block.

The comparator in the ADC1205/ADC1225 is an expanded version of that basic circuit. Several inputs are connected simultaneously so that the reference ladder inputs, the offset and curve correction signals, and of course the analog input all can be

compared at once. Each differential input pair is connected through a different size capacitor so that the relative weight of each input can be tailored. For instance, if an input pair is connected by a 16C capacitor, it has 16 times more influence on the output than a pair connected through a 1C capacitor.

The charge-balancing technique allows the signal polarity handled by any input pair to be reversed, simply by changing the order in which the input switches are closed. The switch that closes when the gain block is shunted then becomes the negative input. In that way, the converter chip can easily work with bipolar and differential signals.



The HP family of pulse/function generators

The shortest route to a long term solution.

Whether your job involves designing tomorrow's advanced digitally-based products, or whether it's up to you to configure the sophisticated ATE systems needed to test them, you can count on Hewlett-Packard for complete solutions to many of your measurement equipment needs. Take the HP 8116A Pulse/Function Generator for example, or its companion the HP 8112A Pulse Generator. Both generate an extensive repertoire of signals throughout their 50 MHz range. Both have the power and versatility to help you keep pace with state-of-the-art developments until well into the next decade. They're exceptionally easy to use, HP-IB compatible, and take up only half the standard rackmount space.

Versatility for a wide range of signals.

Both instruments provide accurate and repeatable waveforms that can be internally shaped. The HP 8112A can be externally modulated for period, width, delay, and level. The HP 8116A in addition to width modulation, provides AM, FM, log sweep and external amplitude hold. Both instruments feature counted bursts.

Use these capabilities to test slew rate and hysteresis of amplifiers, output characteristics of switching power supplies, measure the reverse recovery time of diodes, magnetic

recording head performance and head/media interactions, terrain-following radar accuracy, laser transmission lines, process control systems, and more.

Technical excellence for a long service life.

Both the HP 8116A and the HP 8112A are based on the latest advances in IC technology. One reason we can offer you so much performance in such a compact package is because we make extensive use of custom HP-developed high density ICs. Another reason is our over 30 year leadership position as the supplier of the world's most technically-advanced signal generation equipment.

Find out more today.

At \$4,780* for the HP 8112A, and \$3,950* for the HP 8116A (including burst and sweep), they're the price/performance leaders. We have a complete set of literature including our new "Precision Waveform Sources" brochure. To get your package call your local HP sales office listed in the telephone directory white pages. Ask for the electronic instruments department.

*U.S.A. list price only.

CIRCLE 106



HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.



HEWLETT
PACKARD

0801405



12-bit a-d converter

levels. Narrow-range functions such as linearity correction use small comparator input capacitors ($2C, \frac{1}{2}C$), whereas wide-range inputs such as major bit tests use large values ($18C$). In effect, the input capacitors work with the ladder, distributing charge in much the same way that the resistive portion distributes voltage. These capacitor ratios can be built with high precision in CMOS.

When the action begins

During an analog-to-digital conversion, the chip quickly determines signal polarity and then enters a classic successive-approximation routine. If the comparator sees a negative signal at the input, the converter reverses the polarity of the analog input, a process involving only a timing change at the charge-balancing comparator, not actual switching on the part of the converter. Decoding the four multiplexers—A, B, E, and F (Fig. 2 again)—obtains from the reference ladder the voltage levels to be compared with the analog input for the bit tests. Specific multiplexer selections for each test minimize the numbers of switches and resistors required.

When the successive-approximation routine is complete, data enters three-state buffers for transmission to the data bus. During subsequent read operations, the 1205 issues the results of a complete 13-bit conversion in two bytes, formatting the data with the high byte first and the sign extended. For its part, the 1225 operates in a fully parallel manner and thus transmits all 13 bits simultaneously. In either format, negative numbers appear in a two's complement version or in code.

Grabbing graphics

The a-d converter undertakes graphics digitization with no problem. For instance, when graphics information or other nonkeyed data is being fed to a computer, the converter often must digitize some type of continuous signals, such as those generated by a mouse, trackball, joystick, or special tablet. Even devices that use inherently digital sensors, such as optical encoders, often rely on analog techniques, which boost resolution by interpolating between the transducer's discrete data points.

One increasingly popular input method is a

pressure-sensitive resistance tablet on which someone may write with an ordinary pen or even a finger. Since analog techniques determine the X and Y coordinates, the a-d converter is usually the limiting factor in system resolution.

The tablet consists of a conductive sheet suspended above a fixed surface, which is covered with a uniform resistive coating (Fig. 3a). Pressure causes the surfaces to touch, allowing the point of contact to be deduced from the voltage levels observed on the conductive sheet.

Each coordinate is determined in a separate sequence. The X axis is excited by applying a negative drive pulse, which the tablet's internal diodes steer in the X direction. The voltage that the chip measures at the Sense output is then proportional to the contact point's X coordinate. The Y axis is determined similarly but with a positive drive pulse.

Adding compensating diodes D_1 through D_4 to the converter's reference and signal inputs cancels offsets from the tablet's internal diodes. The converter's reference and differential analog inputs permit positive and negative voltages to be measured without complicated circuitry. Furthermore, the system requires no special stylus or cursor and hence no cord or power for the writing tool.

Locked in a grid

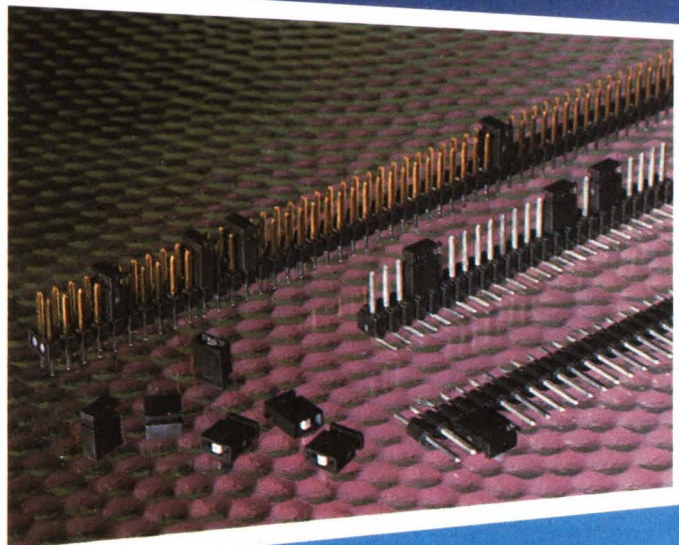
A second type of input tablet, this one geared to high-resolution graphics, uses the 12-bit converter chip to interpolate distances between electrically driven wires embedded in the tablet. Though an active cursor is necessary for this type of arrangement, the tablet can be quite large and, with close wire spacing, can afford extremely high mechanical resolution.

This method of digitization, using an inductive pickup or cursor, employs the wire grid as a transmitter (Fig. 3b). The cursor, which is essentially the receiver, contains a small pickup coil.

If, for example, the Y coordinate of the cursor's position must be found, a current-ramp waveform drives each of the horizontal wires in a sequence, sweeping the tablet's surface in the Y direction. A current ramp in the vicinity of the pickup generates an output pulse whose amplitude is a function of both the ramp's slope

DISCOVER...

Creative Links to  World Electronics

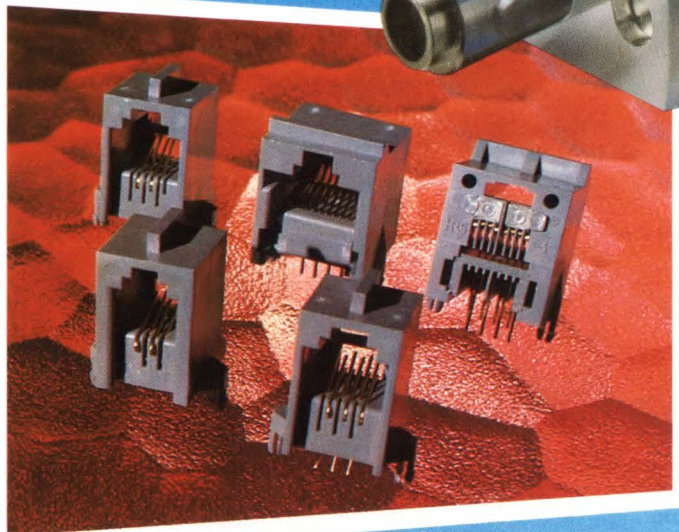


- **HIF3G "Shorty"** End-to-end and side-to-side stackable. Closed top (with easy pull lip) or open top. Tin or gold plating.
- **A1 and A2 Breakable Headers** A1 Double row up to 128 positions. A2 Single row up to 40 positions.

CIRCLE 107

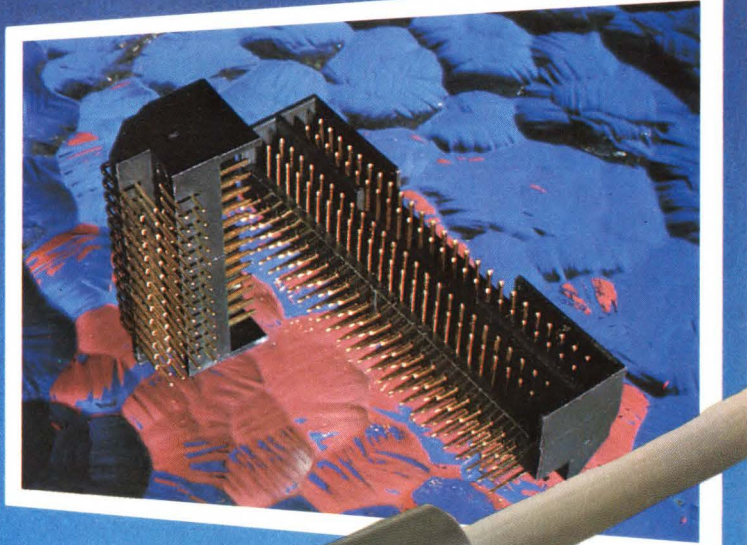
- **Fiber Optics Connectors**
Metal or plastic.
GI or single mode cable.
Screw or bayonet lock.

CIRCLE 108



- **TM5RC** 4, 6, and 8 positions. Industry standard style. 8 Position available with or without shorting clip.

CIRCLE 110



- **HIF3T "Double-Stax"**
Stack design nearly doubles density.

Mates with industry standard IDC or crimp connectors. 52 (2 x 26), 100 (2 x 50) and 120 (2 x 60) positions.

CIRCLE 109



- **Twin Lead Coaxial Connectors**
TWT2 Series - IBM compatible
TWB - BNC shell with twin leads

CIRCLE 111

HRS HIROSE ELECTRIC U.S.A., INC.

9254 Deering Avenue • Chatsworth, CA 91311 • Telephone (818) 709-1247

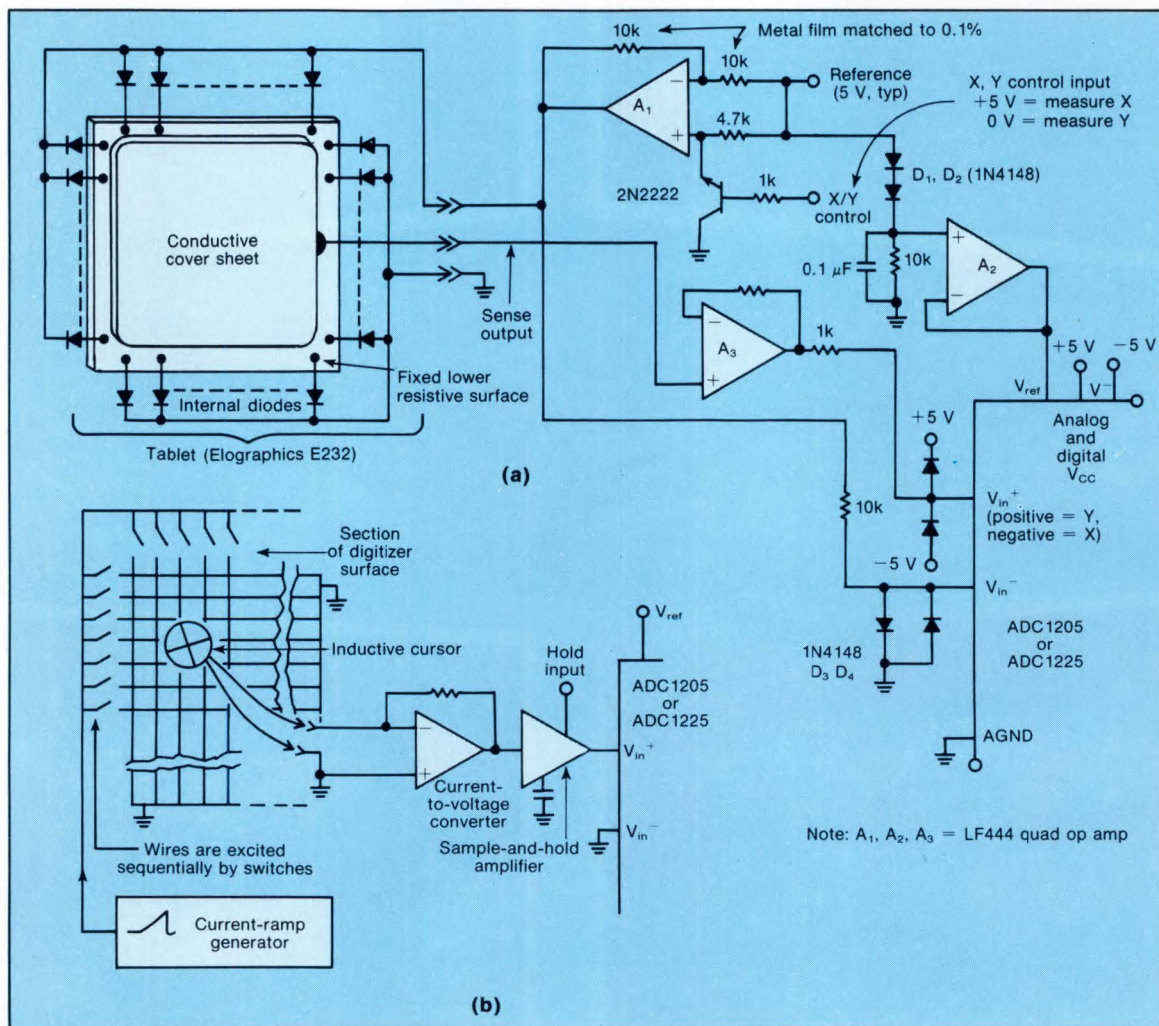
12-bit a-d converter

and more important the coil-to-wire distance.

As the current ramps march beneath the pickup coil and begin appearing on its opposite side, the pickup's output pulses change polarity. As a result, the cursor's position can be coarsely determined from the location of the wires that caused the polarity change; the exact location is generated from the relative amplitudes of the two opposite-sign pulses occurring on either side of the coil. Driving the vertical wires of the grid reveals the X coordinate.

In that application, the advantages of the 1205 and 1225 extend beyond their ability to improve resolution with a 12-bit conversion. The digitizer must measure the bipolar input signals at relatively high speeds, since several ramp-and-conversion sequences may have to be generated before a point's coordinates can be determined. Of course, the conversion speed varies with tablet size—the larger the tablet, the more wires must be scanned.

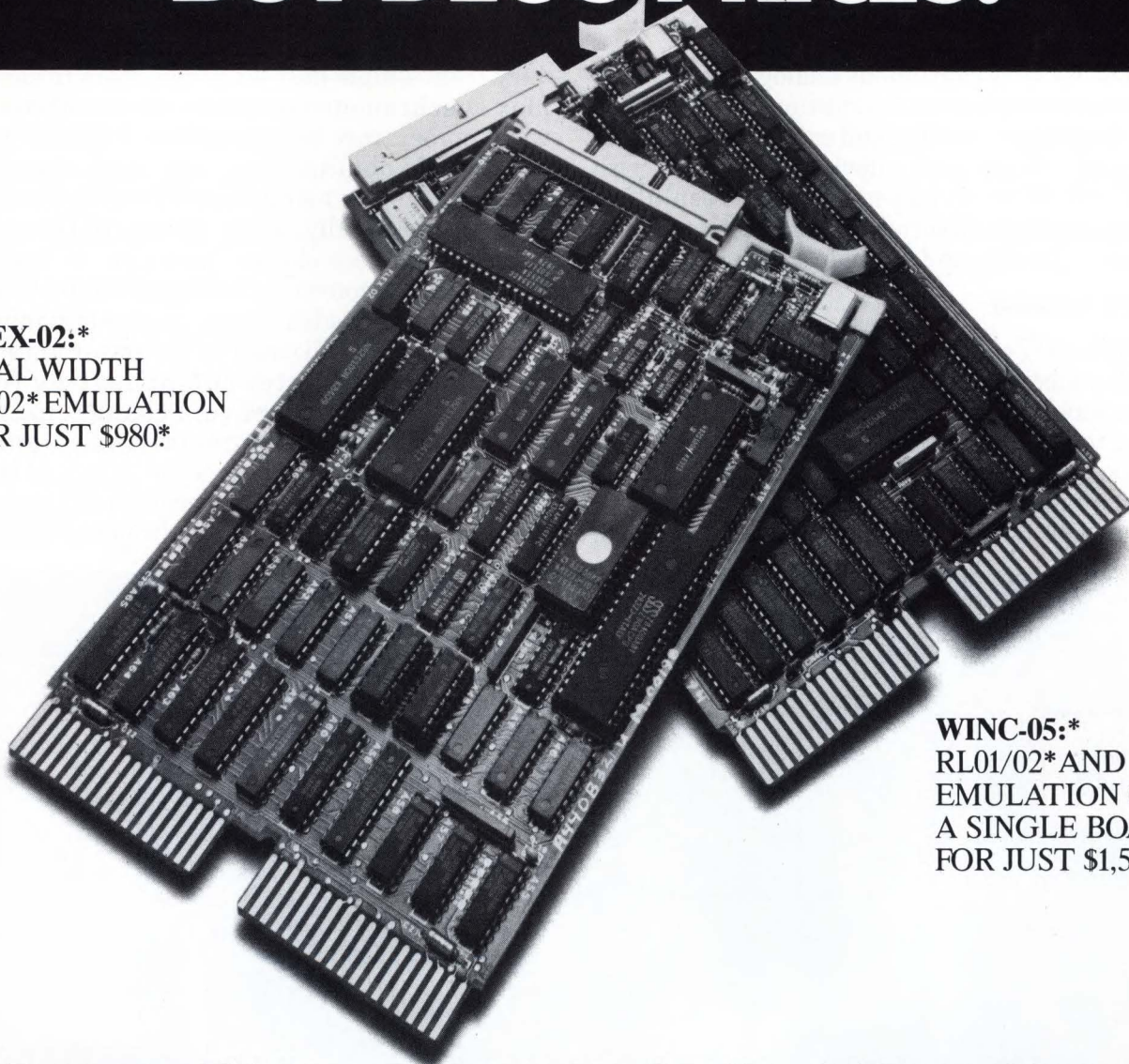
The field of robotics presents an almost lim-



3. When digitizing the voltages from a resistive-type graphics input tablet, the a-d converter affords a resolution of 4000 by 4000 points (a). For an inductive graphics tablet, the chip divides the space between the wires into more than 4000 parts, bringing high resolution to a wide area (b).

OUR DISK CONTROLLERS EMULATE EVERYTHING BUT DEC'S* PRICES.

FLEX-02:*
DUAL WIDTH
RX02* EMULATION
FOR JUST \$980.*



WINC-05:*
RL01/02* AND RX02
EMULATION ON
A SINGLE BOARD
FOR JUST \$1,575.*

To your system, AED's disk controller boards look exactly like DEC controller boards.

To your checkbook, though, they look quite a bit, well, smaller.

This in spite of the fact that both of our products offer significant price/performance advantages over DEC's more expensive RL01/02 and RX02.

The WINC-05, for example, only needs two of the five dual slots a DEC solution requires.

There's one version configured for 5¼" Winchester and floppy disk drives. And there's another version that handles 5¼" Winchesters and 8" floppies. Either way, you get an excellent buy for the money.

And the FLEX-02 delivers 15%-70% faster data throughput than the RX02 for 8" floppies, while using a dual wide instead of a quad wide slot.

Both WINC-05 and FLEX-02 come with their own unique

built-in automatic bootstraps.

To find out more, write us at 440 Potrero Avenue, Sunnyvale, CA 94086, or call 800/538-1730 (408/733-3555 inside CA.)

FLEX-02 and WINC-05 from AED. Because the alternatives are just too DECspensive.

AED ADVANCED
ELECTRONICS
DESIGN, INC.

*OEM discounts available. WINC-05 and FLEX-02 are trademarks of Advanced Electronics Design, Inc. RL01/02, RX02, and DEC are trademarks of Digital Equipment Corporation.

12-bit a-d converter

itless arena for high-resolution position sensing in mechanical systems. For that purpose, a popular transducer—the linear variable differential transformer (LVDT)—is often called to duty.

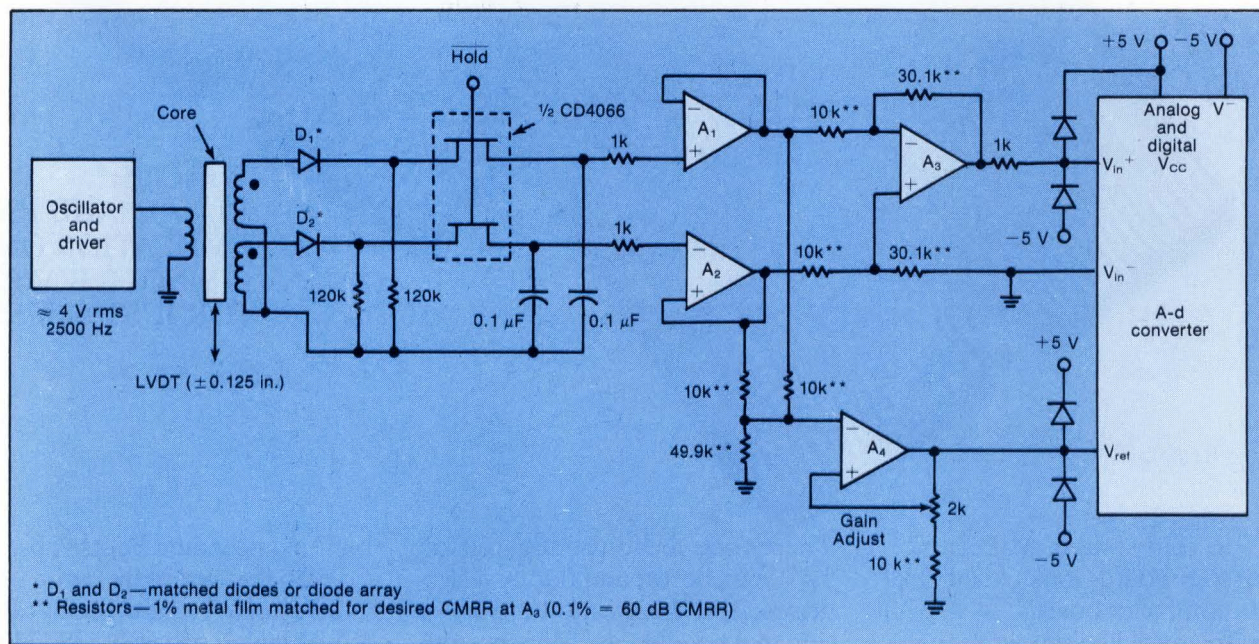
The LVDT's continuous analog output yields unlimited resolution. In addition, it exhibits little mechanical loading and enjoys an extremely long life. When such a device is combined with the converter, it can make high-resolution measurements that turn position detection into a quick, precise, and easily processed job.

LVDT behavior

An LVDT can be thought of as a transformer with a mechanically movable core. Typically, a sine wave drives the primary coil, which is coupled to two secondary coils. The amplitudes of the secondary coils' output signals are directly proportional to the core position and are also each other's complement. As the core moves,

one output rises while the other falls. Prior to digitizing, a demodulator or a rectifier converts these ac output signals into dc levels proportional to position.

Signal-conditioning electronics for LVDTs vary from simple half-wave rectifiers to complex synchronous modulator-demodulators with temperature compensation. A circuit using the chip obtains many high-performance features despite using basic detector diodes (Fig. 4). Specifically, using the sum of the output of the two secondaries (the output of amplifier A_4) as the converter's reference signal has two very definite advantages. It helps eliminate any need for stabilizing the oscillator amplitude. It also obviates compensating for temperature-dependent gain changes in the transformer. Such common-mode signal changes now have no effect on the output of the converter. In addition, the overall circuit incorporates a sample-and-hold amplifier (a CD4066



4. Hooked up with the a-d converter chip, a linear variable differential transformer, or LVDT, can resolve mechanical displacements as small as 0.05 mil.

JAPAN ELECTRONICS BUYERS' GUIDE 1983

A reference book that has ...

The latest and most up-to-date list of names, addresses, telephone numbers, key sales personnel, and other important data on 2,000 leading Japanese companies : 1,500 manufacturers and 500 trading companies.

PART-A Manufacturers classified by products (including manufacturers' catalogs)

This part lists manufacturers classified by products and their product catalogs. The listings of manufacturers by products are divided into 7 sections. In each section, the listings given, each time with addresses and telephone numbers, are further sub-divided. In all, there are more than 2,000 product items included.

Section 1 Audio and video equipment and accessories, general home electric appliances

Section 2 Components, parts, and semi-finished products for electronic and communication equipment

Section 3 Testing and measuring instruments, analysis equipment and other related equipment. This part also contains, as the appendix, the 300 product specifications of oscilloscopes, multi-meters, signal generators, frequency counters, spectrum analyzers, circuit testers

Section 4 Business machines, computer peripherals, other related equipment

Section 5 Wire and wireless communication equipment, broadcast and studio equipment

Section 6 Cables, cords, wires and electronic materials, including chemicals, metals, ceramics

Section 7 Production machines, control equipment, and tools

PART-B Manufacturer directory

This part contains key data on 1,540 manufacturers:

- ★ Address and telephone number ★ Cable address and telex number ★ Capital and annual sales
- ★ Number of employees ★ Establishment year ★ Settlement term ★ Names of president and key sales personnel
- ★ Export sales ★ Bankers ★ Sales breakdown ★ Regional sales breakdown ★ Stock market listing
- ★ Registered trade names ★ Overseas plants ★ Main products

PART-C Trading firm directory

This part contains key data on 550 trading firms handling electrical and electronic products. Main items included are similar to that of the manufacturers' list (PART-B).

PART-D Branches & Agents of Japanese firms

This section lists the address and telephone number of the sales companies, factories, and branches of Japanese firms, as well as the names of exclusive or main agents overseas.

PART-E Trade names

This section contains an alphabetical listing of 1,700 registered trade names and the name of the corresponding manufacturer or trading firm.

PART-F Organizations related to electronics

This part lists Japanese organizations and associations related to the electrical and electronic industries.

ORDER FORM

To: World-Wide Import-Export Promotion Centre,
P.O. Box 503 Marine Parade Post Office,
Singapore 9144, Republic of Singapore.
Tels: 2927550, 7470328. Telex: RS 39194 AB

Banker: Oversea-Chinese Banking Corp., Ltd.,
East Coast Road Branch.

Please send me/us ONE copy of "Japan Electronics Buyers' Guide 1983". Enclosed is a bank draft for S\$400.00 (or US\$200.00).

NAME :

ADDRESS :

.....

Date

Signature :

DESIGN ENTRY

12-bit a-d converter

switch array) that keeps the outputs of the detectors stationary during a conversion.

The converter chip can turn a general-purpose data-acquisition system, such as an analog I/O board, into an even higher-performance, lower-cost setup. In an eight-channel system, for instance, a monolithic junction-FET multiplexer generates the input for a gain-controlled amplifier (Fig. 5), which consists of a precision op amp (an LM11) and a digital gain-setting chip (an LF13007).

More for less

With that arrangement, the computer can select amplifier gains of 1 through 100 in "1, 2, 5" steps. A monolithic sample-and-hold amplifier (an LF398) grabs the signal for the a-d con-

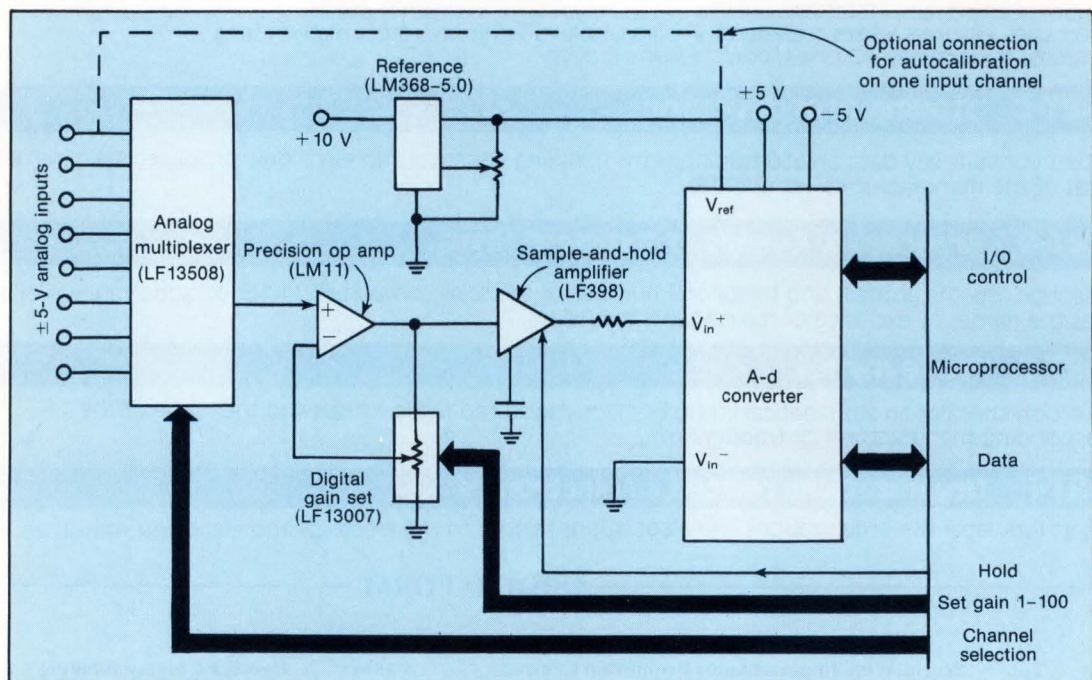
version. The entire system—including the reference—consumes less than 500 mW.

Although the initial error for such a system could conceivably exceed the 12-bit level if no trimming were done, all of the major gain error sources here are fixed. With the gain settings stable over temperature, errors can be corrected by applying the appropriate scale factors during data processing. If desired, one channel can be dedicated as a reference input for autocalibration. □

How useful?

Circle

Immediate design application	544
Within the next year	545
Not applicable	546



5. With a few additional components, the CMOS a-d converter builds an eight-channel data acquisition system that dissipates less than 500 mW.



ONLY SAFT LITHIUM OFFERS SO MANY CHOICES.

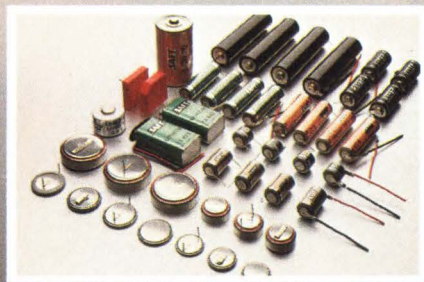
Saft offers you lithium cells and batteries with more choices of couples than anyone else in the industry: everything from our exclusive lithium copper oxide and silver chromate batteries to sophisticated lithium sulphur dioxide and lithium-thionyl chloride batteries. And we can offer you more configurations and more available terminations than anyone else, too.

We offer electro-chemical and module design support to designers of military, medical and industrial equipment from the most delicate surgical equipment to the most complicated microprocessors. And

we're a major supplier to the U.S. Department of Defense and to major OEM defense contractors.

If you're a designer who needs a broad choice in specifying lithium cell batteries, tell your preferences to us at Saft. We'll supply you with the perfect answer to even your most demanding specifications. We're the pioneers in lithium technology.

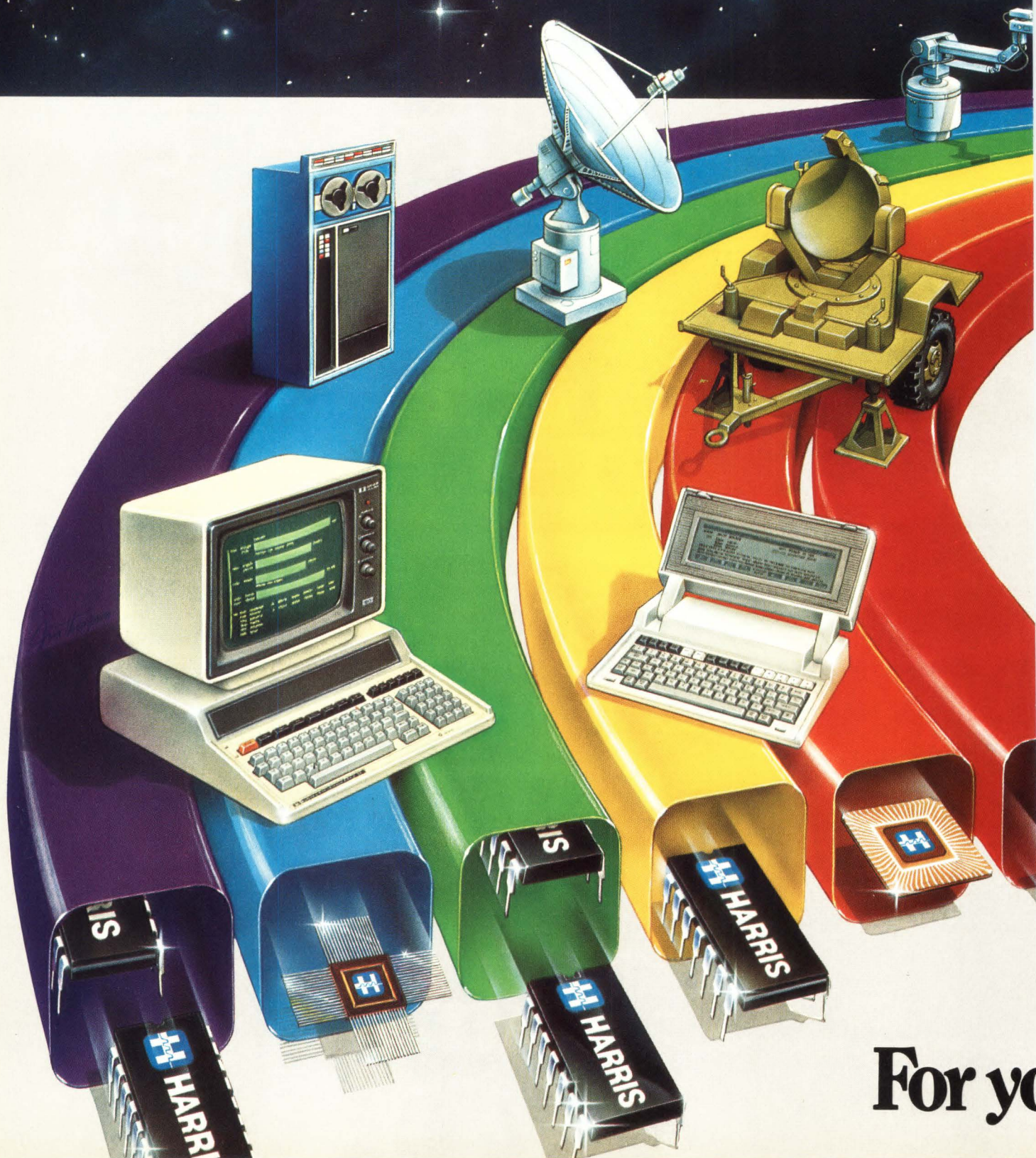
To find out more, contact SAFT America Inc., Advanced Battery Systems Division, 107 Beaver Ct., Cockeysville, Maryland 21030. Or call (301) 666-3200.



CIRCLE 114

SAFT
MORE POWER TO YOU.

Wherever peak performance
counts, our ICs pave the way
for you.



For you



The Harris spectrum. A broad-base line of top-quality ICs supporting a growing roster of leading producers of sophisticated processing and communications information systems.

Maintain a competitive edge. Harris has spent the last quarter-century honing IC technology you can rely on. Consider these recent advances:

- First CMOS Programmable Logic
- First Monolithic SLIC
- First Rad-Hard CMOS 80C85 Family
- First 8/16-Bit CMOS Microprocessor (80C88)
- First Rad-Hard Gate Array
- First Standard GaAs Digital IC Family
- First 16-Bit Monolithic D/A Converter
- First Microprocessor-Controlled Pacemaker

Name any technology or technique. Analog. Digital. CMOS. Bipolar. Standard cells and gate arrays. Semicustom or full custom. Dielectric isolation. Silicon and gallium arsenide. Harris has them all—and the experts to help you select and use them.

Harris paves the way, keeping on track manufacturers of every type of equipment that uses, processes or transmits information. Computers and controls. Regulators and robots. Orbiting satellites and earth stations—and nearly everything in between.

Find out how easy it is to get Harris ICs into your system. Write for the new Harris short form products catalog for more information about the full spectrum of Harris capabilities. We'll help you get the word.

Write: Harris Semiconductor,
P.O. Box 883, MS 53-035,
Melbourne, Florida 32902-0883



A Full Spectrum of ICs.

PRODUCT TECHNIQUES • Standard Products • Programmable Logic • Gate Arrays • Standard Cells • Full Custom	TECHNOLOGIES • Bipolar Digital • Bipolar Analog • CMOS Digital • CMOS Analog • Dielectric Isolation • Gallium Arsenide
LINEAR • Op Amps • Comparators • Voltage References • Analog Switches	DATA ACQUISITION • Analog Multiplexers • D/A Converters • A/D Converters • Sample-and-Hold
ANALOG COMMUNICATION • Subscriber Line Interfaces (SLICs) • CODECs • PCM Monolithic Filters • CVSDs	DIGITAL COMMUNICATION • CMOS 1553 Bus Interface • CMOS UART/Bit Rate Generator • CMOS Manchester Encoder/Decoder • CMOS ARINC Bus Interface
MICROPROCESSOR • CMOS 80C86—16-Bit • CMOS 80C88—8/16-Bit • CMOS 80C85 RH—8-Bit • CMOS 6120—12-Bit • CMOS 8/16-Bit Peripherals	MEMORY • Bipolar PROMs • CMOS RAMs • CMOS PROMs • Bipolar/CMOS Programmable Logic • CMOS Memory Modules
GALLIUM ARSENIDE • Microwave FETs • Microwave Amplifiers • Digital	RADIATION HARDENED • RAMs/PROMs • Microprocessors • Gate Arrays • Op Amps/Multiplexers

Harris Semiconductor: Analog - Bipolar Digital -
CMOS Digital - Gallium Arsenide - Semicustom - Custom



CIRCLE 36

Visit us at the Wescon Show in Anaheim, CA, Oct. 30–Nov. 1 at the Hamilton/Avnet Booth #3680.
Visit us at the Electronica Show in Munich, West Germany, Nov. 13–17 at the Harris-MHS Booth #19A8, Hall 19.

For information, our name is Harris.

DISPELLING THE MYTH ABOUT SINGLE CHIP MICROCOMPUTERS.

This is the first in a series of technical papers from Zilog, designed to give engineers new insights into Zilog microprocessors — what advantages they provide for particular products and why they are the choice among engineers who need optimum performance.



Single chip microcomputers are marvels of advanced electronic technology. Going beyond even the tiny architectures of today's general-purpose microprocessors, they combine the functions of multiple chips to form a single-device solution. Indeed, they are awesome machines.

But after their introduction, myths grew up around MCU's. Designers believed that they were difficult to design with; that there wasn't sufficient hardware and software support for them; that those who selected them would get a Sisyphus Complex. Sisyphus, you remember, is the character in ancient Greek mythology who was condemned forever to push a rock up a hill. Just as the rock reached the top, it escaped Sisyphus and rolled back to the bottom.

Some MCU's, no doubt, deserve the stigma of this myth. But one definitely does not. Zilog's Z8® MCU Family. For there is more than enough evidence to prove that the Z8 chip is not only the fastest MCU around, but it's the easiest to work with, too. In fact, it should be the chip of choice for any dedicated control applications that must get to market

on time — even if you need large quantities of them to fill your needs. Because the Z8 device is available now for off-the-shelf delivery.

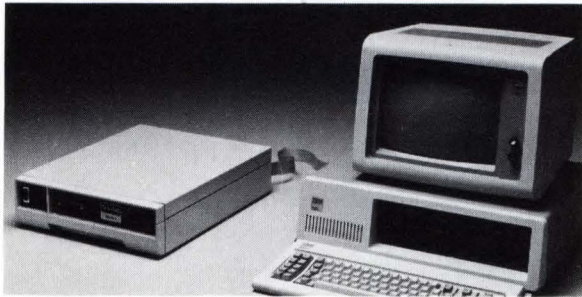
But what does ease of design mean to you? What do you look for when you select a chip? What do you need to make your job easier? Whatever it is, you'll find Zilog provides everything you need, and more:

- Hardware and software development tools
- An existing software base
- Factory and field sales support
- Preproduction parts supplies

Z-SCAN™ 8 PROVIDES REAL-TIME EMULATION CAPABILITIES.

Zilog's Z-SCAN 8 is an in-circuit Emulator with a combination of hardware and sophisticated software that gives you efficient, interactive emulation of the entire family of Z8 microcomputers. By the simple exchange of target devices, the selected Z8 MCU can be emulated in a real-time mode that gives you the ability to inspect and control the

tested environment. It also gives you real-time trace speed up to 12 MHz, two breakpoints, single-step capability and extensive mappable memory. All to ensure that you get an accurate simulation of your Z8 operating environment.



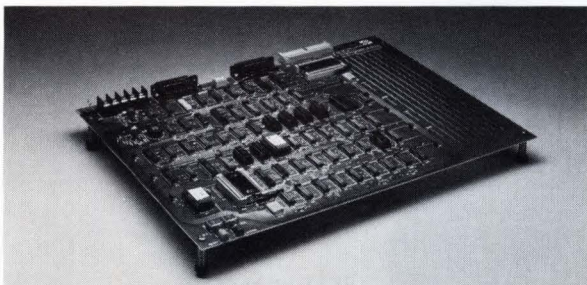
The Z-SCAN 8 Emulator is a combination of hardware and firmware that allows efficient, interactive emulation of the Z8 MCU. When hooked to an IBM PC software host, Z-SCAN 8 provides real-time, in-circuit development system capabilities. The Z-SCAN 8 will connect easily to other PC's making it a highly versatile unit.

The Z-SCAN 8 operates with both Zilog systems and other 8-bit development systems running CP/M® and/or other operating systems. Its standard RS-232 serial link makes it particularly useful with the IBM PC and other CRT terminals. Hardware and software debugging is fast and convenient. Two screens display the status of the Z-SCAN 8 monitor and Z8 MCU target resources. Target memory can be displayed and modified in a scrollable window. Moreover, the Z-SCAN 8 is interactive and easy to use. Commands are selected from menus and command arguments are self-prompting.

The set-up procedure and initialization for the Z-SCAN 8 is done for you—a unique feature in itself. The Z-SCAN 8 is designed to reduce design time. But it's not the only time-saving device Zilog provides for the Z8 MCU.

THE Z8 MCU DEVELOPMENT MODULE CUTS HARDWARE AND SOFTWARE DEVELOPMENT TIME.

The Z8 Development Module (DM) features two 4K Z8 devices on a single-board microcomputer. It's designed to assist you in the development and evaluation of hardware and software designs based on the Z8 MCU. With it, you can easily build a prototype using the Z8 prototyping device, and then develop code that will eventually be mask-programmed onto the Z8 on-chip ROM.



The Z8 Development Module allows you to build a prototype using the Z8 prototyping device, thereby developing code that will eventually be mask-programmed into the Z8 on-chip ROM. The Module is a single-board microcomputer system designed to develop and evaluate hardware and software designs based on the Z8 family.

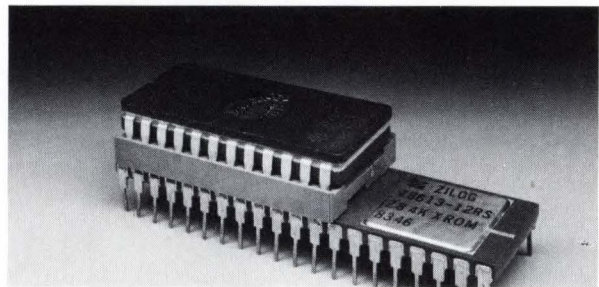
The Development Module connects to the CRT terminal and host system through two on-board RS-232 serial ports. So the DM fits between the CRT and host. A simple command makes the DM transparent in the serial path, which allows software

to be developed on the host-resident assembler without disconnecting the DM from the CRT and host.

The DM has a range of features to make Z8 designs easier than you ever thought possible: • 4096 bytes of static RAM for convenient creation and debugging of user code; • an on-board socket that tests user code in a 2716 or 2732 EPROM; • up to 4096 hardware breakpoints on address compare that can cover the entire internal ROM space; • a wire wrapped area for prototyping; and much more.

Z8 MCU DEVELOPMENT SOFTWARE SPEEDS UP DESIGN TIME.

Zilog also provides you with a growing library of sample programs and convenient assembler packages to help you get started testing your Z8 MCU designs. In our Subroutine Library, for example, there's our arithmetic subroutine, an I/O subroutine and a general control subroutine. What's more, there are several versions of the Z8 device: a 2K and 4K ROM version; a ROMless version; and a Protopak for prototyping. Each offers different memory addressing structures. Zilog is developing more all the time. Plus, there's an existing software base for all the Z8 MCU's. We can provide you with samples of designs currently in use.



The Z8613 MPE is used for prototype development and preproduction of mask-programmed applications. The Protopak is a ROMless version of the standard Z8611, housed in a pin-compatible 40-pin package.

SERVICE AND SUPPORT AT EVERY LEVEL FOR YOUR Z8 MCU DESIGNS

From the factory to the field, Zilog provides support at every level. A worldwide field sales network stands ready to help you with both hardware and software support. And you can get all the Z8 MCU's you need right now. Yields for the device are up 40%, and price reductions reflect our new supplies. What's more the upcoming Z8 Super 8™ promises a smooth migration path for today's Z8 MCU family.

Zilog's Z8 single chip microcomputer. Believe the myths. Or get the facts. If bringing your product to market is important to your business, then design with the part that does more for success than any other. The Z8 MCU makes getting over the design hill and into production a lot easier than you might think.

For more on the Z8 MCU, send for our complete overview or call our Literature Hot Line at 800-272-6560. For seminar dates and locations, or information on Zilog training, call (408) 370-8091. Or write: Zilog, Inc., Technical Publications, 1315 Dell Avenue, MS C2-6, Campbell, CA 95008.

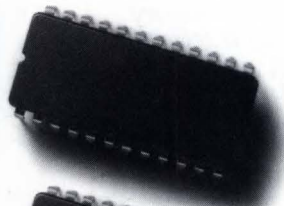
CP/M is a registered trademark of Digital Research Inc. All other products mentioned are either registered trademarks or trademarks of Zilog, Inc.

Zilog Pioneering the Microworld

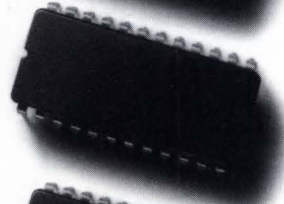
an affiliate of
EXON Corporation

"See us at Wescon, Booth #3669 and
at Electronica '84, Stand 18, D60, 18"

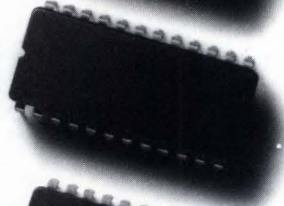
While everyone quit at 5,



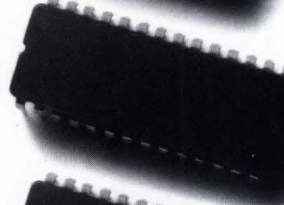
2K x 8 latched



2K x 8 latched timer,
2816A compatible



2K x 8 latched,
full military temp.



2K x 8 latched timer,
2817A compatible



8K x 8 latched timer

It's not that we're gluttons for punishment.
It's just that at Seeq we take the E²ROM business seriously. So seriously that our engineers insist our parts fit your designs, not vice versa.

Maybe they got a little carried away.

At last count, they'd developed 12 different E²ROMs. Outperforming their counterparts at other companies two to one.

And they're responsible for more E² improvements than any other design team.

Most of these innovations quickly became industry standards. Like 16K densities. Single 5-volt power. And leadless-chip-carrier packaging.

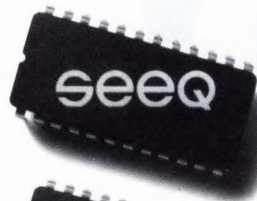
The rest are still unduplicated. Like our high-density, high-performance 64Ks. Exclusive DiTrace.[™] Our industry-leading 1ms byte-write. And the world's first E² with million cycle endurance.

Plus there are plenty of ideas still on the drawing board. Because when it comes to designing new E²s, our engineers just hate to quit.

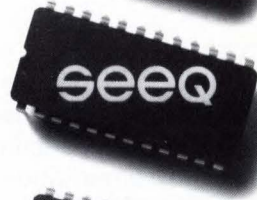
Especially while they're ahead.

For information on the industry's most innovative E²ROMs, write or call Seeq Technology, 1849 Fortune Drive, San Jose, California 95131. Telephone (408) 942-1990. Or circle number 75 on the reader service card.

we worked until 12.



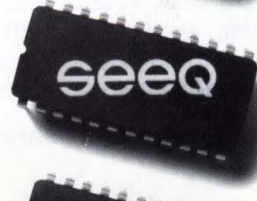
2K x8 latched



2K x8 latched,
1ms write



2K x8 latched timer,
2ms write



2K x8 latched timer,
1M cycle endurance



2K x8 latched,
full military temp.



2K x8 latched,
2816A compatible



8K x8 latched



8K x8 latched,
1ms write



8K x8 latched,
full military temp.



2K x8 latched timer,
2817A compatible



2K x8 latched timer,
2817A w/1M cycle
endurance



8K x8 latched, 1ms write,
full military temp.,
1M cycle endurance

WHEN WE MAKE IT SMALL YOU MAKE IT BIG!

You can expand your profit margins when we shrink your circuitry. Indeed, acquiring more circuitry on a single integrated circuit is a competitive necessity for most electronics manufacturers. An ever-diminishing number of companies can afford the luxury of an in-house semiconductor resource. Progressive companies now look to Pacific Microcircuits Limited (PML) for full semiconductor resources at affordable prices. At PML we solve your system problems with innovative IC designs.

PML is a full capability custom/semicustom component house. We design gate arrays, standard cell or full custom circuits for analog systems, digital systems or mixed analog/digital systems. We implement all designs using state-

of-the-art CMOS VLSI processes. In addition to supplying parts that address specific needs, we recommend the best implementation and design approach for your application. No volume is too small to excite our imagination.

PML possesses extensive experience in ISO-CMOS and double poly ISO-CMOS design techniques; processes that combine ruggedness, reduced size, exceptional speed and low power consumption. These processes can be applied separately or in combination to achieve a wide variety of analog and digital requirements.

For affordable relief from shrinking profit margins, contact:

"PML . . . a resource you can profit from"

Head Office:

Pacific Microcircuits Ltd.
1645 - 140th Street
White Rock, B.C.
Canada V4A 4H1

Telephone: (604) 536-1886
Tom G. Foxall

Eastern Sales Office:

Pacific Microcircuits Ltd.
96A Glebe Avenue
Ottawa, Ontario
Canada K1S 2C3

Telephone: (613) 592-5630
Gene M. Cohen

PACIFIC
MICROCIRCUITS LTD.

Digital oscilloscope is quick on the trigger to nab elusive glitches

*The triggering system for a 1-GHz digital-signal scope
breaks radically with tradition but brings
an element of certainty to an uncertain domain.*

This is the second in a series of articles that focus on the HP 54100 digital oscilloscope. The first, which appeared in the Oct. 18 issue, introduced the technical details of the instrument itself, and this one uncovers the scope's unique triggering mechanism. The next will examine ways to characterize ECL chips in a circuit without the usual difficulties associated with making subnanosecond measurements.

Triggering an oscilloscope trace with high-speed digital signals is a world apart from working with analog or lower-frequency digital waveforms. As clock rates climb to 250 MHz—in some cases to 500 MHz—and edge speeds drop below a nanosecond, designers of logic systems need more precise tools to tame this unfamiliar world.

An advanced approach to triggering marks the latest 1-GHz-bandwidth digitizing oscilloscope. Without such a refined technique, neither of the two versions of this instrument, the HP 54100A and HP 54100D, would be able to track down the elusive causes and consequences

of, say, crosstalk, glitches, and incorrect delays. Lead length, termination mismatches, and other high-frequency issues can be dealt with as well. Working with the scope, an engineer can establish stable, repeatable, and easy-to-control trigger points in the face of a myriad of signal-related problems.

Among the triggering system's high points are its 500-MHz upper frequency limit and its independently set thresholds for each of the channels and trigger inputs. Also of importance are the repeatable results that can be had in spite of narrow pulses or marginal signals, plus an ability to recognize logic patterns. Moreover, the system's powerful hold-off mechanism prevents signal bursts from tripping a trigger too often, among its other jobs. It is called into play either by pulse edges or by time intervals and is independent of any of the scope's display settings. Finally, controlled by the instrument's 68000 microprocessor, the trigger system can be set up automatically, vastly simplifying the task of picking a signal's trigger point.

These features, essential for stalking high-speed digital problems, are what set the triggering system apart from the conventional tacks taken to capture signals, which are based on simple voltage thresholds (see "A Fresh Approach to Triggering," p. 248). In addition, the system accommodates widely varying pulse widths and repetition rates, as well as periods involving numerous transitions or varying

Ed Evel, Hewlett-Packard Co.

Ed Evel is a development engineer at HP's Colorado Springs Division. Since coming to the company in 1965, he has worked in a number of fields, including oscilloscopes, probes, computer systems, and laser trimmers for thick-film hybrids. Evel designed the trigger hardware for the HP 54100. He holds a BSEE from Kansas State University.

Digital oscilloscope

numbers of them.

The first major difference in the trigger system is the separate trigger-threshold comparators on each of the two vertical channel inputs and on the external trigger input (Fig. 1). The immediate advantage to this approach is improved high-frequency performance. Low-level signals are no longer routed and multiplexed to a single comparator, as is traditionally done, consequently reducing overall noise and improving the match among signal transmission lines. Also, independent comparators allow a trigger to be qualified by the logic pattern across all of the inputs. And since each comparator's threshold is set independently, different signal slopes and logic families like ECL and TTL can be mixed.

The heart of any triggering system is its comparator, the speed and precision of which determine overall performance. In this case, the

multiple comparators must make accurate and repeatable comparisons between a gamut of input signals and a predetermined threshold—even at high frequencies. Moreover, input signal amplitudes may vary over a range of 100:1, may afford very little overdrive above the threshold, and may display differing pulse widths. Yet each comparator must respond with subnanosecond accuracy. And each one's hysteresis must be set high enough to reject noise but not so high that sensitivity is sacrificed.

Custom comparators

To achieve its high internal sensitivity (10 mV up to 100 MHz and 20 mV beyond 100 MHz), broad dynamic range, and 500-MHz upper frequency limit, the trigger's comparators are implemented with thick film hybrid circuits and high-frequency custom ICs. All signal connec-

A fresh approach to triggering

In a conventional oscilloscope, whether analog or digital, the sweep is triggered whenever a signal crosses a set threshold. That approach is inadequate for displaying accurate, jitter-free images of high-speed digital signals and their ailments.

The problem arises because high-speed digital signals are plagued with glitches caused by coupling, like cross-talk, and transmission-line reflections. Although these cause sporadic problems that are best observed with an oscilloscope, only one with an innovative scheme to trigger on these phenomena and their effects can pave the way to tracking down and correcting them. At high speeds, signal paths are usually transmission lines and, together with pulse transitions will generate reflections when not ideally terminated. More specifically, a 10-pF load on a 50- Ω transmission line creates a 25% reflection from a 1-ns step. The resulting glitch, combined with random noise, can push a signal across its logic threshold and induce hard-to-find soft failures. Similarly, crosstalk between adjacent lines also can cause glitches.

Tracking down these problems in high-speed digital systems is of primary importance, since they are easily caused and can have serious consequences. Yet conventional trigger schemes fall short when attempting to display such glitches.

Another problem for conventional triggers, called double triggering, can occur while attempting to trigger a sweep on relatively slow transitions on which high-frequency noise is superimposed. Here,

the noise can cause multiple transitions across a trigger threshold. As a result, a scope might trigger on the trailing and leading edges of a waveform even though only the leading edge was selected. Typical trigger systems attempt to sidestep this pitfall with a low-pass filter, which, given the filter's fixed cut-off frequency, is a compromise at best.

Additionally, in troubleshooting digital systems, an individual transition within a burst of pulses is frequently the object of interest. Choosing a particular transition for scrutiny requires either that a trigger be established on one edge among many or that the trigger be qualified by a logic state. Both demands outstrip the ability of traditional scopes, instead, demanding a trigger mechanism more like that found in a logic analyzer.

In all cases, a trigger system should maintain the accuracy and stability of its threshold even when the trigger pulses themselves vary. For example, pulse width and repetition rate may vary, as may overshoot, amplitude, and edge speed. But a tenacious trigger system will remain fixed to one point, regardless. In such cases, the key to consistency is a high-speed comparator with a delay that is constant, even when the amount of a signal's overdrive changes or drops to marginal levels.

Finally, a desirable set of features is that the trigger settings be programmable, repeatable, and predictable even for complex settings. For a scope that is left unattended, as in an automatic test setup, these features are essential.

tions are made with 50- Ω coaxial cable and microstrip lines. The result is an accurate, predictable, and programmable system that needs no tweaking to ensure stable, jitter-free triggering.

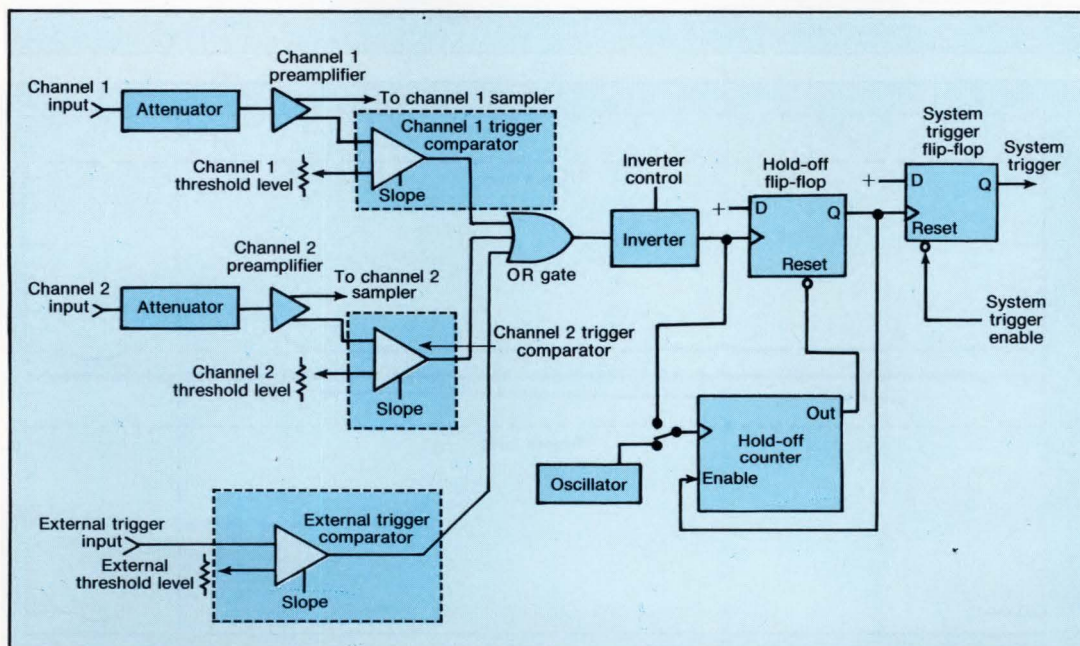
The system's ability to trigger, with minimal timing degradation, on any selected threshold of a narrow pulse is a testament to the hybrid comparator's performance (Fig. 2, top). The pulse shown is 2 ns wide, and the trigger point is at the screen's center. The upper trace demonstrates that even with the trigger set near the top of the waveform, where the input supplies almost no overdrive, there is only about 100 ps of threshold error above that found with the trigger set near the bottom of the signal, where overdrive is abundant.

Timing stability in the face of varying pulse widths is another of the comparator's strengths (Fig. 2, bottom). The system's high bandwidth

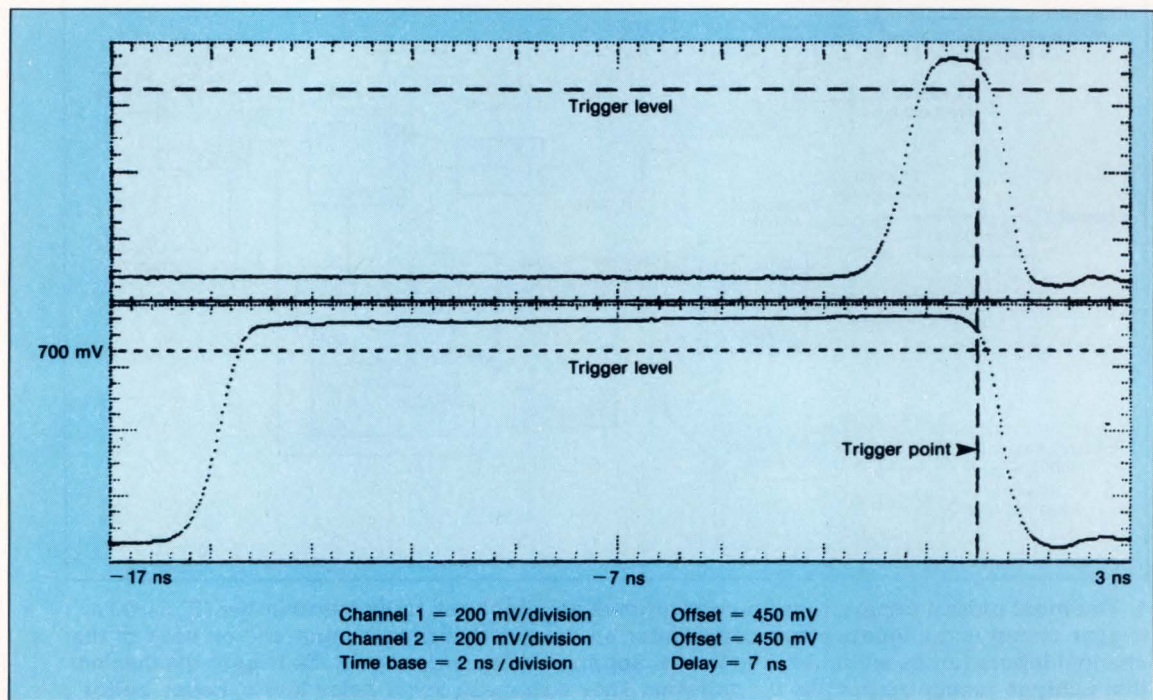
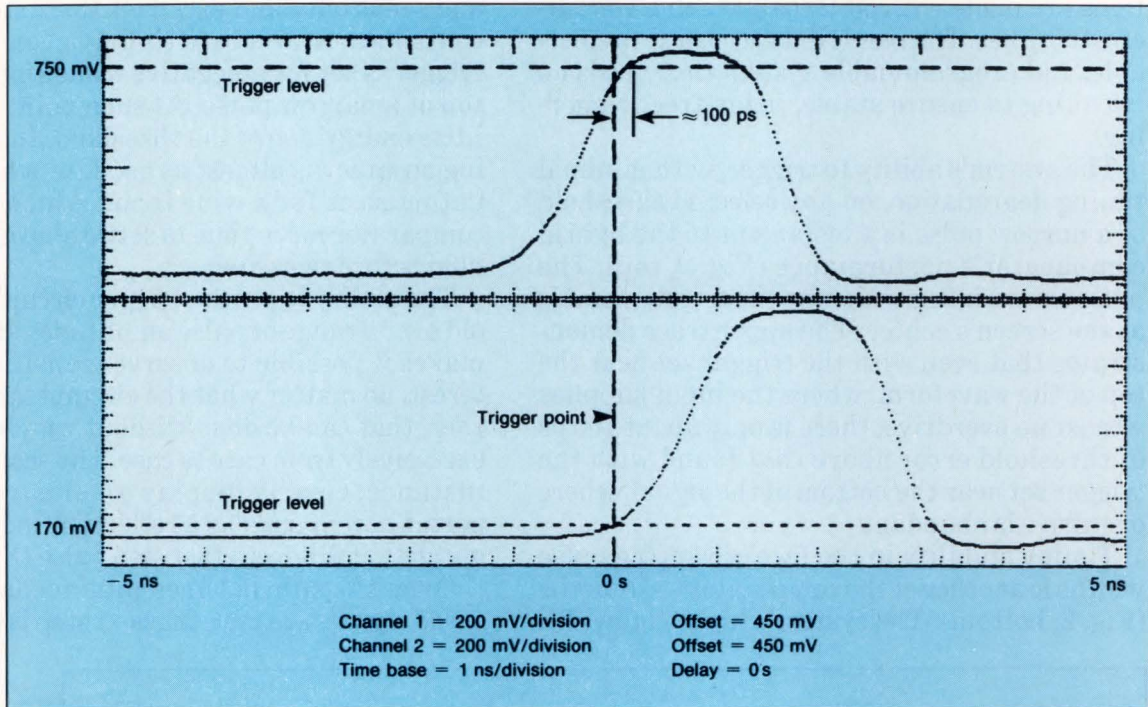
and sensitivity and excellent thermal stability contribute to accurate timing, even when the trigger is set for a negative transition near the top of a narrow pulse. At such points, there is little energy above the threshold. Indeed, timing accuracy is almost as good for a narrow input pulse as for a wide input, which gives the comparator more time to settle above its threshold before switching.

The ability to set the trigger circuit's threshold over a range of pulse amplitudes and widths makes it possible to observe transitions of interest, no matter what the circumstances. Further, that can be done without varying timing excessively from case to case. The scope can, for instance, clearly display an elusive but important event such as a reflection-induced 1-ns glitch that follows a fast step pulse (Fig. 3).

Once the subtle threshold needs of high-speed signals are met, the next step is to qualify



1. The most radical departure from conventional architectures to be found in the HP 54100's trigger circuit is the independent comparator on the external trigger input and on each of the channel inputs (areas within broken lines). Separate comparators give the trigger mechanism the ability to recognize parallel bit patterns. They also mean lower noise levels, hence better sensitivity, because there is no need to multiplex the trigger sources.

Digital oscilloscope*(text cont'd. on p. 252)*

2. The triggering system requires very little signal overdrive, a condition that usually results in severe timing errors, but shows a mere 100-ps discrepancy between the set and actual trigger points (top). Pulse-width variations also have very little influence on the trigger system's stability (bottom).

FUNCTION GENERATOR ONE-UPMANSHIP:



EXACT didn't wait for low cost to happen, we created it!

\$1995.00*



IEEE-488

Introducing the Model 627 The 13 MHz Function Generator solution to the ATE testing needs of the ANALOG WORLD.

The Model 627 is a GPIB programmable sine, square and triangle function generator. It offers complete automatic calibration, non-volatile storage of settings, variable symmetry waveforms, haver and inverted waveforms, and gated or triggered operation.

Amplitude to 10 Volts p-p into 50 ohms, DC offset to ± 5 Volts peak into 50 ohms, and a frequency range from 0.1 MHz to 13 MHz are all displayed at will on a 3½ digit LED display. This programmable generator boasts a frequency accuracy of 0.1% during continuous autocal; far better than any other non-synthesized GPIB function generator, and you'll find no lower price anywhere.



DYNATECH NEVADA
INCORPORATED



EXACT
electronics

2000 ARROWHEAD DRIVE, P.O. BOX 1925
CARSON CITY, NEVADA 89702 (702) 883-3400
TOLL FREE 800-648-7952, TELEX 170054

CIRCLE 224 FOR MORE INFORMATION
CIRCLE 225 FOR DEMONSTRATION

*Domestic U.S. price only.

Digital oscilloscope

the trigger in terms of the input pattern across all channel and external trigger inputs. To this end, each comparator's output is connected (by coaxial cable) to the input of a high-speed OR gate (see Fig. 1 again). The gate generates a logic OR trigger from a pattern across all three of the scope's inputs. Moreover, the pattern need be present for no longer than 1 ns.

If desired, the inputs and outputs of the OR function can also be inverted to change it into a logical AND. Pattern-sensitive triggering with the AND function is of particular importance when a signal line has several transitions but those of interest are related in time to another logic signal. In that instance, the second signal, by virtue of the ANDed inputs, qualifies the trigger. Finally, if pattern triggering is not needed, individual comparators can be turned off.

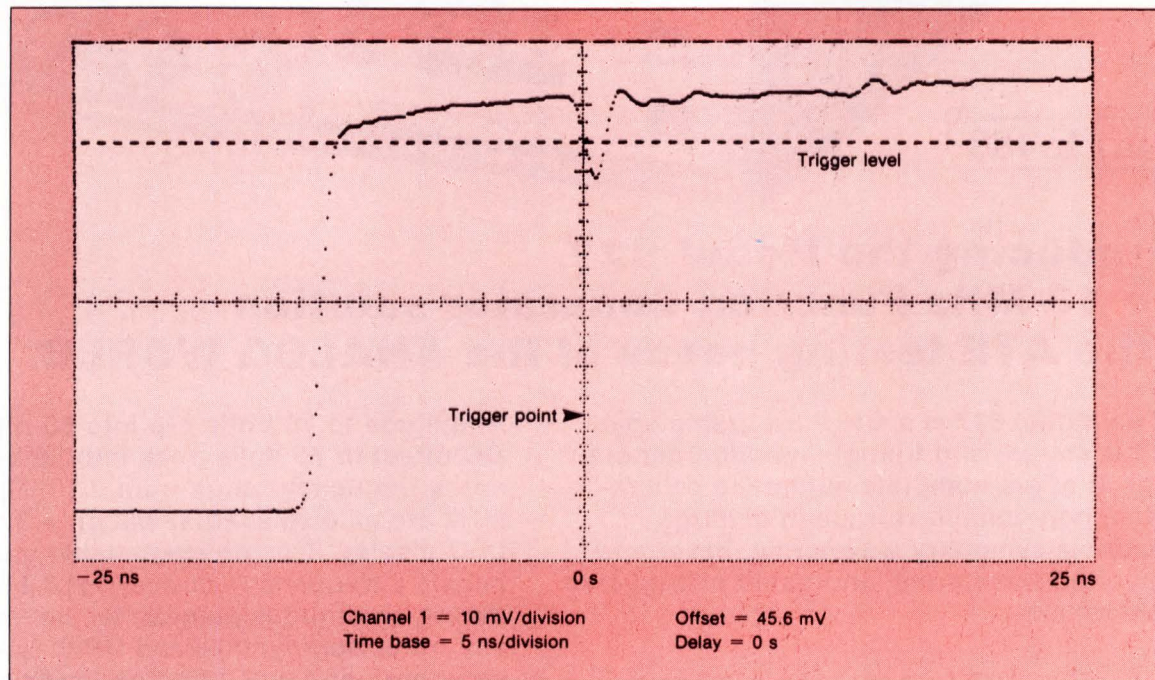
After logic-pattern recognition, the trigger circuit takes on the important task of hold-off. Hold-off disables the trigger circuit for a preset

interval and is the instant between a trigger occurring and the time the circuit will accept another one. In the new scope, hold-off is set by specifying either an interval of time or a preset number of transitions.

Heavy-duty hold-off

Trigger hold-off is not new to oscilloscopes. It is employed to prevent double triggering on noisy signals that have slow transitions or to obtain a stable trigger from one transition among many, as in pulse bursts. Conventionally, a trigger is held off during the sweep and retrace time. Therefore, extending the latter to just before the next desired trigger is an obvious way to create the desired hold-off.

The new scope's trigger circuit sharpens the precision of its hold-off feature. What's more, it is independent of the sweep settings and is programmable. For example, in conventional scopes the range of hold-off adjustments possible by varying the retrace-time is only a few



3. Exemplifying the trigger system's ability to discern small threshold changes over a wide dynamic range is its pinpointing of a 1-ns glitch following a fast step pulse. The glitch is caused by a transmission-line reflection and, when combined with noise, could cause an unwanted switch in logic states.

D.A.T.A. BOOKS® are like having 18 researchers at your fingertips...



but much easier to manage.

If you're an electronics engineer, chances are you've already heard about D.A.T.A. BOOKS. You may even be among the thousands of engineers who use one or more of our 25-plus publications daily.

Whatever information you need for your projects, D.A.T.A. BOOKS have it. Electrical specs... logic drawings... package design... device replacement... manufacturing sources... and more. D.A.T.A. BOOKS reference over 852,000 types of products from nearly 1,000 major manufacturers worldwide.

Our information is complete, accurate and up to date because we contact these manufacturers continually to get the technical data you need to complete your project faster and more efficiently. We know the information you require because

we've been in the business since 1956.

Inside D.A.T.A. BOOKS, you'll find easy to use standardized performance specifications, block drawings, alternate sources of supply, functional equivalence data, manufacturer locations and more.

You'll save time and money by contacting *only* those manufacturers you really need to for the best price and availability.

Your time is much too valuable to waste calling manufacturers and paging through out-of-date catalogs when you can have D.A.T.A. BOOKS do it for you!

Publications include — **Integrated Circuits:** Digital ICs, Linear ICs, Interface ICs, Memory ICs, IC Functional Equivalence Guide, Microprocessor ICs, Microcomputer Systems, Modules/Hybrids and Audio/Video

ICs. **Discrete Devices:** Transistors, Diodes and Thyristors. **Special Devices and Directories:** Optoelectronics, Power Semiconductors, Power Supplies, Microwave, Master Type Locator, Microprocessor Software and Applications Notes. **Discontinued Devices:** Digital and Audio/Video, Interface and Memory, Linear, Transistors, Diodes, Thyristors, Optoelectronics, Microwave and Type Locator.

Call or write us today. Or contact the D.A.T.A. BOOKS representative nearest you.

Toll-Free (800) 854-7030
Inside CA, call (800) 421-0159

D.A.T.A., INC.

P.O. Box 26875
9889 Willow Creek Road
San Diego, CA 92126

D.A.T.A. BOOKS Representative Listings: **EAST:** Motion Engineering, MA (617) 485-2144; Astroprep, NY (516) 422-2500, NJ (201) 826-8050; Motion Technology, DE/MD/DC/VA (800) 482-6318; Stegman Blaine, PA/WVA (513) 729-1969. **SOUTH:** Motion Technology, NC (800) 532-6849, TN/SC/GA/AL/FL (800) 482-6318; Blackburn Associates, TX/LA/AR/OK (214) 692-8885, TX (713) 463-1354. **MIDWEST:** Stegman Blaine, OH/KY (513) 890-7975, (216) 871-0520, (513) 729-1969; Enco Marketing, MI (313) 642-0203; JHS Associates, IL/IN/WI (312) 741-9070. **WEST:** Dynatech, CO/UT (303) 773-2830; Applied Controls Northwest, WA (206) 775-2999, (509) 922-1762, OR (503) 257-7408; Leddy Associates, No. CA/NV/HI (415) 969-6313; Varigon Associates, So. CA (213) 322-1120, (714) 855-0233, (619) 576-0100. **CANADA:** Tech-Trek, (416) 674-1717, (604) 273-1800. **INTERNATIONAL:** (619) 578-7600 or TLX: 910530606.

Digital oscilloscope

times greater than the duration of the sweep. Therein lie two limitations. First and foremost: No hold-off values very much greater than the sweep's cycle are possible. Second, any changes in sweep speed influences hold-off as well, an inconvenient and potentially troublesome effect since changing the sweep speed is a common part of examining waveforms.

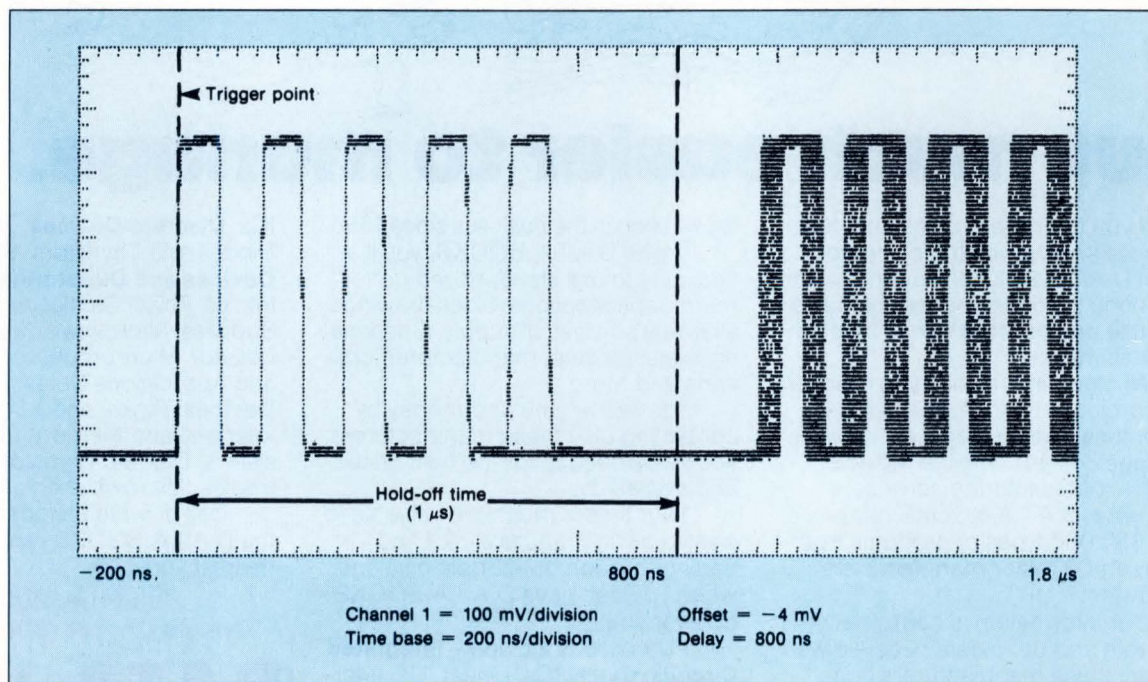
All in the family

The scope's trigger-circuit architecture is closer to that of a logic-analyzer trigger than that of a conventional oscilloscope. (At 500 MHz, though, its operating frequency is much higher.) This is because the combination of pattern triggering and hold-off greatly helps designers to obtain stable triggers on common logic signals and events. Hold-off alone helps obtain a stable display because it inhibits triggers for a specified time following an event. That lets the user trigger the scope on, say, the

first transition within a burst, while rejecting others. It is thus much easier to obtain a stable trigger point on periodic waveforms having more than one trigger-threshold crossing within a period.

What's more, the hold-off circuit can also be set to inhibit system triggers for a programmed number of threshold crossings. That locks the scope onto bursts of similar signals that not only have a fixed number of transitions within a period but also exhibit a widely varying repetition rate.

A typical job for trigger hold-off time is displaying a pulse burst that has a changing number of pulses and a varying repetition rate (Fig. 4). In this case, after the trigger point (left side of the screen), the hold-off feature disables subsequent triggers for 1 μ s. That delays the occurrence of the next possible trigger until the interval between the bursts: In other words, the next trigger is enabled following the last pulse



4. The hold-off feature of the trigger circuit offers two options for observing pulse bursts and other serial data streams; time interval and edge counting. For example, after triggering once, the hold-off mechanism disables subsequent triggers for 1 μ s, showing a clear display of one burst (above). Using the second option displays a burst with a fixed number of pulses by counting five pulses before triggering on the sixth (opposite page).

of one burst but preceding the first pulse of the next. As a result, triggering occurs only on the burst's first pulse.

Right on the mark

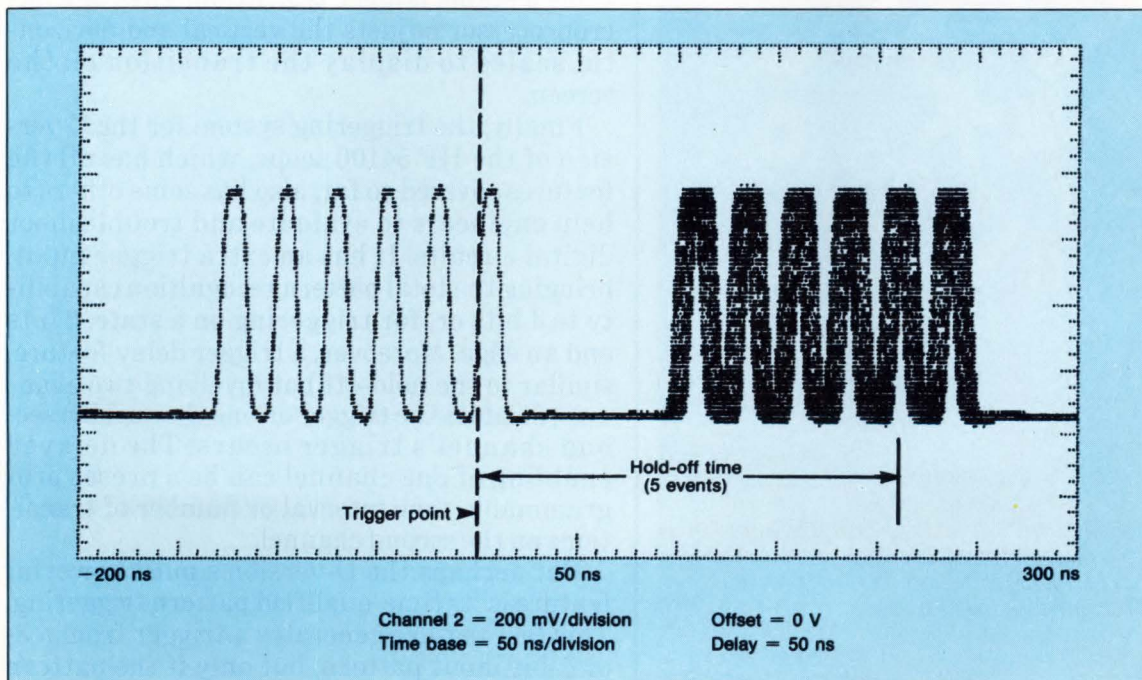
Hold-off time can be set accurately and easily and, on bursts with a relatively constant repetition rate, on any edge within the burst. That is accomplished by setting the hold-off time at slightly less than one period and toggling the trigger slope control to walk the trigger point through successive plus and minus slopes.

As mentioned, in some cases a stable trigger point is easier to obtain if the hold-off is set for a specific number of threshold crossings rather than for a specific interval. A burst displaying a fixed number of pulses but a very variable repetition rate is a good case in point (see Fig. 4 again). With six pulses in a burst, for instance, holding the trigger off for five of them causes the scope to always trigger on the sixth. As with

a time-specified hold-off, toggling the slope control steps the trigger point to earlier pulses.

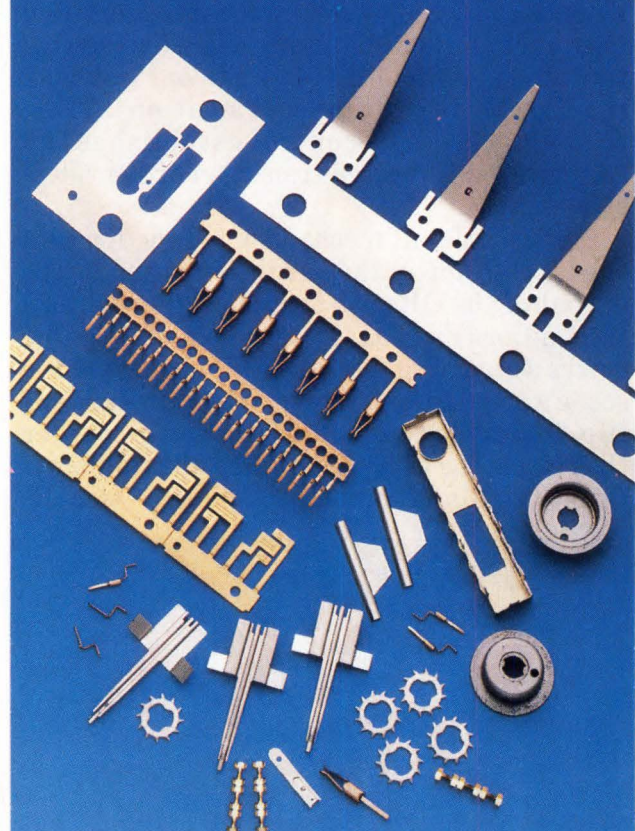
Besides its implications for digital circuits, the last ability is also useful for synchronizing with video signals. A designer can observe any video line in detail by setting the threshold level to trigger on the video-sync pulses and setting the number of hold-off events to one less than the number of sync pulse transitions. Then, toggling the slope control establishes the trigger for any desired transition of the video-sync signal.

For the hold-off mechanism to function as it does, a flip-flop in the circuit is clocked by the output of the OR gate that is used in pattern recognition (Fig. 1 again). The hold-off flip-flop drives a second that controls all triggers to the scope's acquisition system. When the hold-off flip-flop is clocked, it starts a down-counter that resets the hold-off flip-flop and inhibits it from accepting further clock pulses. Once the



Just in time...

The quality precision metal parts you need, when you need them.



With TEC handling your precision parts needs you can get 100% quality, statistical process control and just in time delivery. Plus, you'll see a positive change on your bottom line.

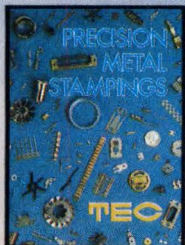
Of course, regardless of whether you want just in time delivery or a warehouse-full order, you still get high TEC quality and supertooling, tolerances to $\pm .00015$, plus maximum production efficiency of your long run microminiature, miniature, and medium size stampings. 10,000 to millions of parts per month.

Call or write for free literature.

TEC

THOMAS ENGINEERING CO.

7024 Northland Drive
Minneapolis, MN 55428
Phone: 612-533-1501



CIRCLE 121

DESIGN ENTRY

Digital oscilloscope

counter reaches zero, the hold-off flip-flop is again enabled and clocked by the OR gate's output. Subsequent edges out of the flip-flop start the scope's acquisition system by clocking the system-trigger flip-flop, but only if the system-trigger-enable signal is true (indicating that the data-acquisition system is ready). Thus when a trigger occurs, the hold-off circuit ensures that no more edges can be accepted for an interval that is determined by the hold-off oscillator, which is crystal-controlled and precise to within 10 ns. Alternatively, the counter can be set to track trigger edges instead of time to invoke the hold-off feature's edge-counting option.

Although the hold-off function certainly simplifies life for an engineer, the most convenient aspect of the triggering system is probably its automatic scaling mode. With the push of a button, the scope's internal microprocessor varies the trigger threshold until it finds a stable trigger transition. Then the microprocessor adjusts the vertical and horizontal scales to display the transition on the screen.

Finally, the triggering system for the D version of the HP 54100 scope, which has all the features covered so far, also has some others to help engineers to evaluate and troubleshoot digital circuits. It has an extra trigger input, bringing the total pattern recognition capability to 4 bits or, for triggering on a state, 3 bits and an edge. Moreover, a trigger delay feature, similar to the hold-off but involving two channels, disables the trigger on one channel if a second channel's trigger occurs. The delayed enabling of one channel can be a preset programmable time interval or number of transitions on the second channel.

But perhaps the D-version's most powerful feature is its time-qualified pattern triggering. This last feature generates a trigger from a 3- or 4-bit input pattern, but only if the pattern prevails (or does not prevail) for a specified amount of time. □

How useful?

Circle

Immediate design application	547
Within the next year	548
Not applicable	549

New Single and Dual Darlington Power Transistor Modules



Since their introduction, the proven reliability and time-saving advantage of Westinghouse Dual Darlington Modules have made them a popular design alternative to wiring multiple transistors in parallel. Their use, however, has been limited to 1,000-volt, 50-amp and 100-amp transistor circuit applications.

But that's not the case anymore. We've just expanded our Darlington line to include 450-volt and 1,000-volt dual modules in 30-amp, 75-amp and 150-amp continuous current ratings.

And for applications requiring single transistor circuits, you now have the luxury of using Westinghouse Single Darlington Modules. These new units are available in both 450-volt and 1,000-volt versions that include 30-amp, 50-amp, 100-amp, 150-amp, 200-amp and 300-amp current ratings.

Westinghouse expands the Darlington line to increase your design options.

Every module in the Westinghouse Darlington line offers large forward and reverse bias safe operating area for greater power handling capability and fast switching. And every one is reliable.

They're reliable because they utilize planar technology and glass passivation. The transistors and diodes in each module are sealed against the elements. The transistors are triple-diffused planar processed with no exposed junctions, and the diodes are glass passivated chips offering much greater parameter stability.

The Westinghouse Darlington line also offers high gain, to keep system circuitry simple. And they can be used effectively in AC and DC motor control and other inverter power supplies.

Here's something else to consider: The wide range of current classes available in the Westinghouse Darlington line at 450 volts and 1,000 volts now makes it possible for you to design reliable, simplified power stages from 1 kVA to more than 100 kVA. At affordable prices.

For more information about the new and complete line of Westinghouse Single and Dual Darlington Power Transistor Modules, write Westinghouse Electric Corporation, Semiconductor Division, Youngwood, PA 15697. Or call (412) 925-7272.

Westinghouse Power Semiconductors

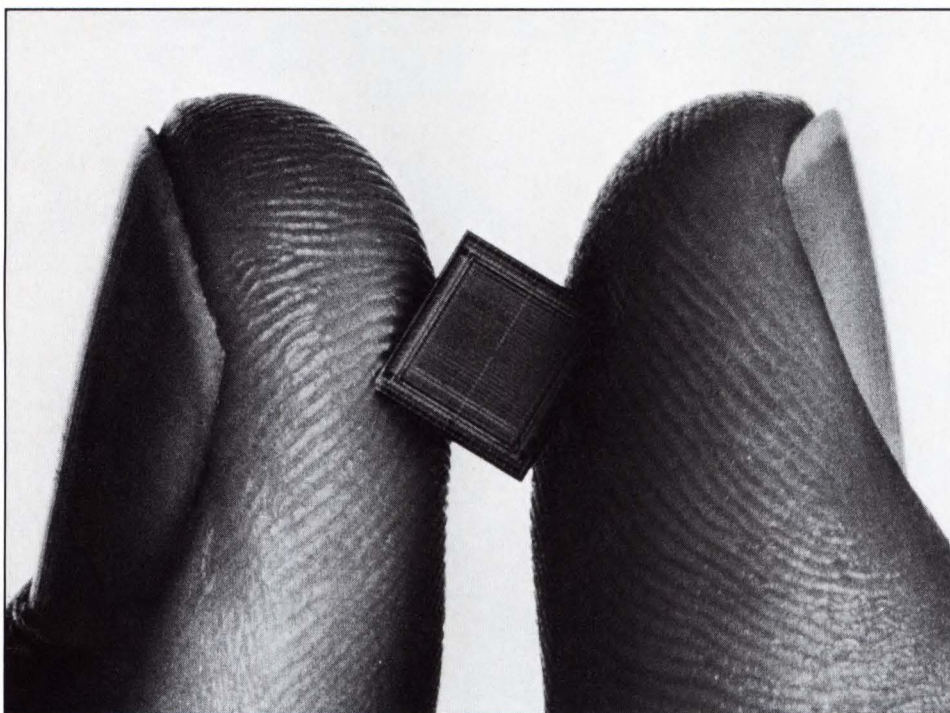
**LIFETIME
RELIABILITY**

You can be sure . . . if it's Westinghouse



- 1. I wonder if I can get
13,000 gates?**
- 2. I wonder if I can get
6,000 gates in a
40 pin DIP?**
- 3. I wonder if I can get
some analog functions
in my gate array?**
- 4. I wonder if I can
convert to standard
cells tomorrow?**
- 5. I wonder if I can get
it all today?**

Wonder no more... The answer is YES from GE Semiconductor!



GE Semiconductor is promising 2-micron double-metal gate arrays. And shipping them now. How can we ship now when our competition can't? Because GE Semiconductor has total in-house capabilities to design, manufacture, and test your gate arrays. And the whole process takes place under one roof at our ultramodern facility in North Carolina's Research Triangle Park.

Not only can we deliver on your new designs, we can provide an alternate source to your LL5000 gate arrays and we can upgrade your LL7000 designs.

Give us a call and tell us what you need. Once you do, all you'll be wondering is what took you so long.

For more information, call (919) 549-3377. Or write: GE Semiconductor, Custom Integrated Circuits Department, General Electric Company, MS-8, Mailstop IM-13, One Micron Drive, Research Triangle Park, North Carolina 27709.



"SEE THE FULL LINE OF GE SEMICONDUCTOR PRODUCTS AT WESCON BOOTH #3428-3433"

We need VLSI

HMOS II.
CMOS.
HCMOS.

Signetics is out to become a leader in MOS VLSI.

We're out to hire the brightest minds in the industry to establish and manage our new VLSI Design facility in Albuquerque.

You'll be working on next-generation microprocessor and microcontroller VLSI derivatives.

You'll be taking it on literally

from the ground up. Working out of a recently-completed 400,000 sq. ft. MOS campus. Enough room for at least four fabs. Plenty of room for advanced product development activity.

You'll have the latest state-of-the-art equipment. Including IBM and VAX[®] computers. Mentor workstations. Plus advanced Calma graphic support.

You'll have the CAD software and you'll have the support.

And you'll have the backing of the vast resources of Philips Labs, our parent company.

See if one of these spots fits you to a "T."

Engineering Manager

You're a seasoned semiconductor designer with at least three years management experience. You've designed microcontrollers or microprocessors and hold at least an MSEE. Your job will be to set-up and manage a center for microcontroller designs.

Graphics Manager

You're already a graphics

EE VIPs ASAP

manager or know you can be one. Either way, you'll be managing a MOS layout design group for the VLSI Design Center. You must have experience in coordinating the layout of major MOS designs. Knowledge of on-line design techniques is highly desirable.

CAD Manager

You've set up and managed an Integrated Circuit CAD Computer System. Experience with VAX 11/780 is a must and knowledge of IBM 308X and Mentor workstations a plus. You should

hold a BS in Computer Science or equivalent degree. Your job will be to set up and manage a CAD system for the VLSI Design Center.

General

We also need experienced microcontroller and microprocessor Design Engineers and MOS Layout Designers. Participation in the design of a microprocessor or advanced peripheral and familiarization with MOS logic and circuit design techniques are preferred.

Don't miss this golden opportunity.

Nor the advantage of living in the clean, crisp sunshine of Albuquerque.

Its lifestyle and cost of living are second to none. Cultural and recreational activities abound.

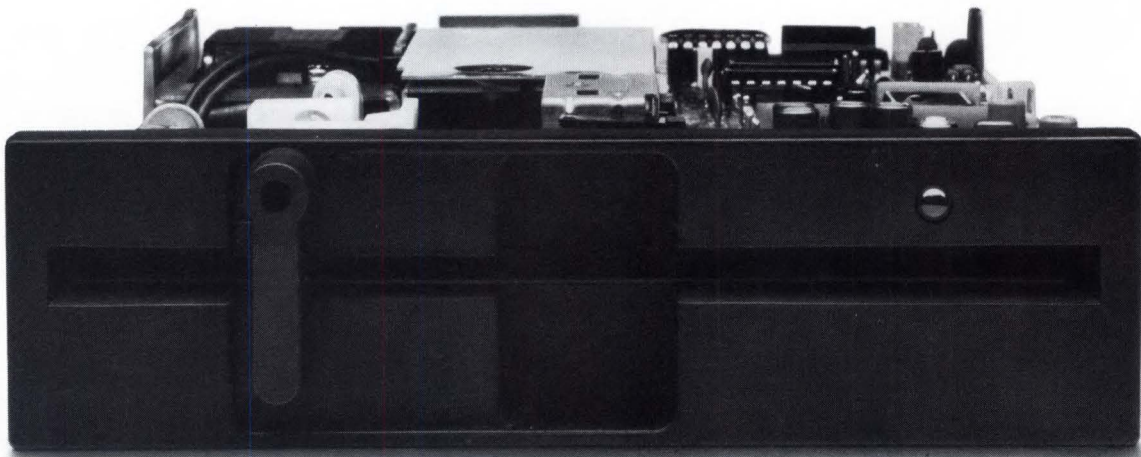
We invite you to contact us for more information.

So RSVP. Call Mark Thomas, collect. Try between 8-5, Pacific Time.

And, of course, Signetics is an Equal Opportunity Employer.
(408) 746-1344

VLSI from Signetics
a subsidiary of U.S. Philips Corporation

HOW TO GET ALONG WITH IBM.



At 1.2 MB formatted, the Shugart 475 offers true 8" performance in a 5.25" package.

It's easy. Design your multiuser PC/AT* compatible system with Shugart's 1.6 MB half-height Minifloppy™ disk drive. The Shugart 475.

At 96 tpi, it's plug compatible with the IBM PC/AT drive. And comes equipped with a dual speed motor.

Which means backward compatibility to read 48 tpi diskettes. And that means you need only one drive to build your PC/AT compatible system.

With the Shugart 475, your compatible system design can be less expensive, simpler and more functional. While getting along just fine.

In addition, the Shugart 475 offers a true-ready command buffering feature to speed controller functions in multiuser applications. Thereby increasing system throughput.

There's even a latch-ready disk change option to alert the system without starting the drive when a disk is removed or changed. As a result, operators on the network can't interfere with other users' data.

Best of all, the Shugart 475 is available in production quantities now.

For true 8" performance in a 5.25" package, be the first to call Shugart at (408) 737-7900.

Learn how easy it really is to get along with IBM.

Shugart

Right from the start.

Milpitas, CA (408) 263-2600, Costa Mesa, CA (714) 979-1935, Thousand Oaks, CA (805) 496-5388, Rochester, NY (716) 235-7190, Minneapolis, MN (612) 546-4411, Richardson, TX (214) 234-3568, Framingham, MA (617) 879-1700, Saddle Brook, NJ (201) 368-8445, Smyrna, GA (404) 436-0953, Markham, ONT (416) 475-2655, Paris, France (3) 946-42-66, Munich, West Germany (089) 786-021, London, U.K. (44) 4862-27272, Wanchai, Hong Kong (852) 5-733307, Hamilton/Avnet, authorized distributor © 1984 Shugart Corporation

*IBM PC/AT is a trademark of International Business Machine Corporation.

SCSI chip simplifies host-peripherals interface for microcomputer use

The first dedicated chip capable of driving the SCSI bus directly can serve as either an initiator or a target and supports device disconnection and reconnection.

Both users and system integrators benefit when the I/O channel between a host computer and its peripherals is standardized. Minicomputers have used such a standard, the Small Computer Systems Interface (SCSI), since the early 1980s. But until recently, designers of microcomputer-based systems, with their more stringent size and cost constraints, found the SCSI overhead too great for practical use.

The NCR 5380, by integrating all the SCSI hardware on one chip, makes it more attractive than ever for designers to use the standard with the smaller computers. The chip's simple architecture, centering largely on 13 registers, simplifies use. The CPU it serves can control any signal it issues by writing to the appropriate register, and the CPU can sample the state of

any SCSI signal simply by reading the appropriate register. An input register saves data until it can be read, and an output register saves data until it can be sent.

Data transfers on the SCSI bus ordinarily take place between an initiator, such as the host, and a target, such as a disk or tape drive. However, a peripheral device like a communications controller can also be an initiator, and the host itself may be a target. Because it can operate in either mode, the 5380 chip, like the earlier 5385, can be used as the traffic-managing element in an intelligent host adapter, for example, or as the SCSI interface on a peripheral controller.

Unlike the older chip, however, the 5380 can drive the SCSI bus directly, thanks to open-collector transceivers capable of handling an output current of 48 mA. The new interface chip also reduces other external logic requirements by not needing an external clock and by being able to drive the host or peripheral controller bus directly. Yet, though all of its outputs handle above-normal current, the chip dissipates only 0.6 W.

The CPU interface of the SCSI chip accommodates either an I/O port or a memory-mapped implementation and supports DMA transfers at up to 1.5 Mbytes/s. The SCSI bus interface provides hardware support for bus arbitration, device selection and reselection, parity generation and checking, and detection

Ron Engelbrecht and Harry Mason, NCR Corp.

Ron Engelbrecht is currently manager of product technology development at NCR's engineering and manufacturing facility in Wichita, Kans., where his responsibilities lie in advanced development and optical and speech products. He holds a patent in the area of CPU design and he has an MSEE from the University of Missouri at Rolla and an MS in engineering management science from Wichita State University.

Harry Mason graduated from the University of Missouri in Columbia with an MSEE in 1977. After stints at Texas Instruments and Basic Four, he joined NCR's Microelectronics Division in Colorado Springs three years ago. He is currently senior principal applications engineer.

SCSI interface chip

of changes in bus phase and of a free bus.

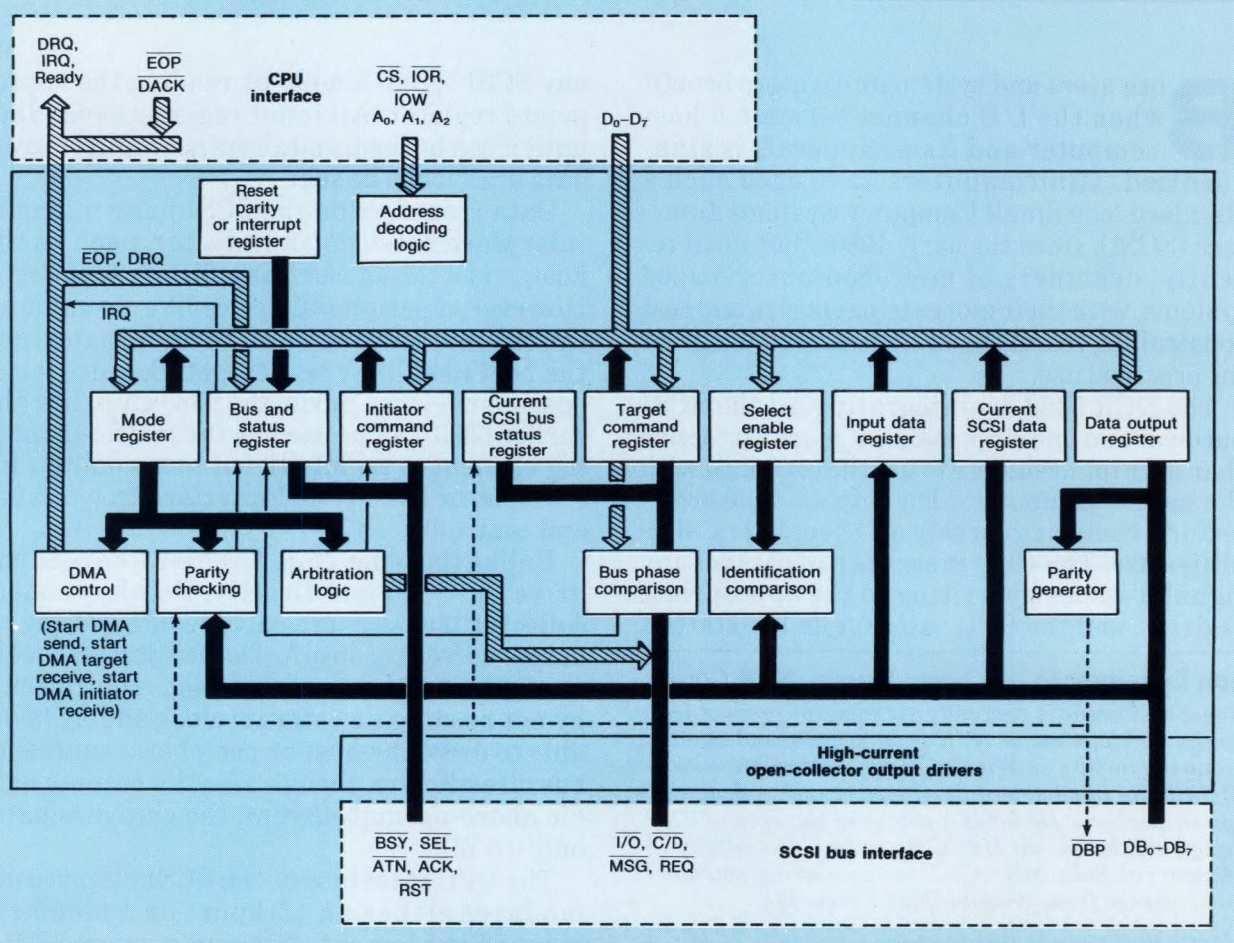
The chip's transceivers create a single-ended interface with an SCSI bus. The 5-V-only 5380 chip comes in a 40-pin package. If differential operation is required for greater noise immunity and operation over 25-meter distances, the NCR 5381 will accept the connection of 75176-type differential transceivers to its control lines and to each of its data lines. This 48-pin version of the 5380 chip will be available next spring.

The inside picture

The SCSI chip's 13 registers include eight that connect directly both to the SCSI bus and to the CPU interface (Fig. 1). Four of those

eight registers link up with the SCSI data lines. They are the data input and output registers; the current SCSI data register, which reports on the lines' status; and the select enable register, which checks device identification. The SCSI bus's nine control lines and optional parity line link up variously with the other four registers: the initiator and target command registers, the current SCSI bus status register, and the bus and status register. An internal bus links these eight registers not only to the CPU data bus, but also to the mode register, which selects the operating phase of the SCSI bus and also controls the three DMA registers. There is also a reset parity or interrupt register.

Although there are thirteen registers, three



1. The NCR 5380 SCSI controller chip includes command registers that allow it to perform both the initiator and target roles in an intelligent I/O processing system. Additional features include bus arbitration logic and parity generation and checking. Control and status lines detect when the SCSI bus is free and provide device selection and reselection signals.

address lines (A_0 to A_2) and two I/O read and write lines ($\overline{IOR}$ and $\overline{IOW}$) are all the CPU needs to address the registers. Five registers are write-only, five are read-only, and three are read or write (Table 1).

In operation, the chip issues SCSI control and data signals, emptying them from its internal registers onto the SCSI bus in response to write signals from the CPU or any DMA logic involved or in response to signals from other devices linked to the SCSI bus.

The mode register uses 4 of its 8 bits to describe the current internal state of the chip—that is, whether it is in an arbitration phase, in a DMA byte transfer or block transfer mode, or in the target mode. The other 4 bits monitor whether the bus is busy (BSY), enable parity checking, and issue two types of interrupts. The initiator command register uses the Attention signal (ATN) to interrupt other SCSI devices and the Select (SEL) command to choose the devices to talk to. It raises Busy flags (BSY), and it issues an Acknowledge signal (ACK) in recognition of attempts by other devices to get hold of the bus. The initiator command register is also used to enable the SCSI data bus (3 bits) and to control the reset logic. The target command register uses only 4 bits to provide the same kinds of signals, but primarily as responses to another initiator.

Direct memory access can occur in either a byte or a block mode, both being signaled by the mode register. To access data in the block mode, the chip asserts Data Request (DRQ) on the DMA control lines, and the system responds by asserting Data Acknowledge ($\overline{DACK}$) for the remainder of the block transfer. The chip transmits a Ready signal to control the system DMA transfer rate. In some applications it may be desirable to use the block mode but still retain the byte-wide handshake of DRQ and $\overline{DACK}$. This is possible if the system releases $\overline{DACK}$ after each DMA cycle. The chip will then issue a new DRQ for each byte of the transfer. The Ready signal will still be available if needed.

Though this technique may appear very much like the byte-mode transfers, it is faster. In the byte mode a DMA transfer is completed when $\overline{DACK}$ ends. In the block mode a DMA transfer is completed when $\overline{IOR}$ or $\overline{IOW}$ end. In the modified block mode, the DRQ signal is 30 to 40 ns faster than the Ready signal and a new DMA cycle can be started sooner.

Polling or interrupting

The SCSI chip can operate in a polled or an interrupt-driven environment. In the polled environment, the current SCSI bus status register and the bus and status register together monitor the changing conditions on the nine SCSI

Table 1. Registers of NCR 5380 SCSI chip

Address	Read by CPU	Written by CPU
00	Current SCSI data	Output data
01	Initiator command	Initiator command
02	Mode	Mode
03	Target command	Target command
04	Current SCSI bus status	Select enable
05	Bus and status	Start DMA send
06	Input data	Start target-receive DMA
07	Reset parity or interrupt	Start initiator-receive DMA

SCSI interface chip

bus control lines. The interrupt output is used to indicate the completion of a specified task (such as the end of a DMA transfer or the selection of an initiator) or to flag an abnormal result (such as bad parity or inappropriate SCSI bus activity).

The various interrupt conditions are enabled or disabled by 2 bits of the mode register or by the select enable register. When an interrupt occurs, the bus and status register can be read to determine the interrupting condition.

To signal the completion of a DMA transfer, the end-of-DMA bit in the bus and status register is set by the End of Process signal (EOP) from the DMA logic. Then if the Enable-EOP interrupt in the mode register has previously been set, the SCSI chip will generate an Interrupt Request (IRQ).

Success in selecting a target device (or reselecting an initiator) will also cause the chip to issue an interrupt. A target has been successfully selected when SEL is true and BSY is false for at least 400 ns and the correct ID bit is also asserted, as determined by a match between the SCSI data bus and the contents of the select enable register. Only a single bit match is required to create an interrupt.

The parity of incoming data, if used, is checked during reading of the input data register. Bad parity causes an interrupt if the Enable Parity Check and Enable Parity Interrupt bits are active in the mode register.

When the information being transferred on the SCSI bus is not the type required, a bus phase mismatch is indicated by the Phase Match bit of the bus and status register, and the IRQ signal is sent to the CPU. Meanwhile, on

the SCSI bus side, neither is the pending REQ acknowledged (ACK) nor will the SCSI data bus be driven until the mismatch is resolved.

To detect a phase mismatch, the chip continually monitors the Message (MSG), Command (C/D), and I/O signals on the SCSI bus, indicating the type of information being transferred (Table 2). The signals are compared with the corresponding bits in the target command register, always on the falling edge of Request (REQ) in the same register. The result, as reflected in the Phase Match bit, is always true when the associated device is operating as a target, because the SCSI chip is then driving these signals. But a mismatch can occur if the device is connected as an initiator, and a mismatch will generate an interrupt if the DMA bit is active in the mode register.

The SCSI chip can also be programmed to issue an interrupt upon receipt of an SCSI Bus Reset (RST, active) signal or upon unexpected loss of BSY. To protect against a wired-OR glitch, BSY is delayed internally for at least a bus settling time (400 ns) before IRQ is asserted.

Two interface options

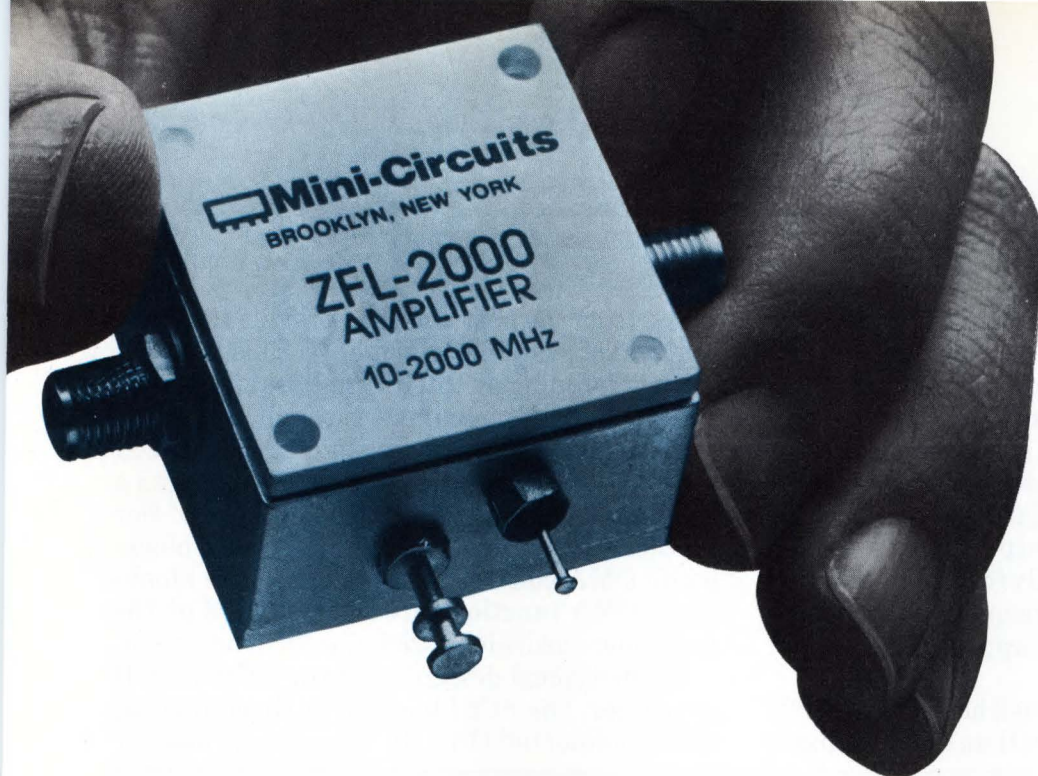
For a simple interface on the host side, the SCSI chip is placed on the CPU board and mapped as a peripheral device into the CPU's I/O address space (Fig. 2a). In this configuration the host CPU handles all tasks related to managing the bus and transferring data. The configuration is useful for single-user and single-task systems, since there will be no multiple or overlapping seeks to trouble the host processor. Programmed I/O, using the input and output data registers on the chip, is probably the quickest method of transferring short blocks of data, such as command and status information.

With some processors, additional interface logic is required to map the chip properly into the system's address space. If the interface chip is on the host CPU board or system motherboard, that address logic can probably be shared with other I/O ports or memory devices.

The simple interface can be enhanced by addition of a DMA channel (or by use of an existing DMA channel on the motherboard) to direct data between the system memory and the SCSI

Table 2. SCSI bus information transfer phases

Bus phase	SCSI bus lines		
	I/O	C/D	MSG
Data output	0	0	0
Unspecified information output	0	0	1
Command	0	1	0
Message output	0	1	1
Data input	1	0	0
Unspecified information input	1	0	1
Status	1	1	0
Message input	1	1	1



amplify or isolate? it does both.

22 dB gain and 40 dB isolation, 10-2000 MHz... only \$179

Either way, the ZFL-2000 miniature wideband amplifier is an engineer's problem solver. Some examples of solutions offered by the ZFL-2000 are

- Boosting signal/sweep/synthesizer outputs to 50 mW.
- Achieving broadband isolation, especially when combining 2 signal generators for a two-tone intermodulation measurement.
- Increasing the dynamic range of spectrum analyzers.
- Driver for power amplifiers, such as Mini-Circuits' 1 and 2 watt ZHL series.
- Extending the frequency range of signal generators when using a frequency doubler, filter and then amplifying.
- Creating multiple output ports for one signal generator when amplifying and then adding a Mini-Circuits power splitter or divider.

These unconditionally stable wideband amplifiers are available with SMA connectors and are housed with an internal heat sink in a rugged 1.25 in. sq. by 0.75 in. high RFI shielded case.

Meets MIL-STD 202, these units operate from -55°C to +100°C.

One week delivery and a one-year guarantee, of course.

For complete specifications and performance curves refer to the Goldbook, EEM, EBG, or Mini-Circuits catalog

ZFL-2000 SPECIFICATIONS

FREQUENCY	10-2000 MHz
GAIN	20 dB
GAIN FLATNESS	±1.5 dB
OUTPUT POWER (1 dB compression)	+17 dBm
NOISE FIGURE	7.0 dB
INTERCEPT POINT (3rd order)	25 dBm
VSWR, 50 OHMS	2:1
DC POWER volt, current	+15 V, 100 mA
HEAT SINK	Internal
OPERATING TEMP	-55°C to +100°C

CIRCLE 125

finding new ways...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
P.O. Box 166, Brooklyn, New York 11235 (718) 934-4500
Domestic and International Telex 125460 International Telex 620156



C98 REV. A

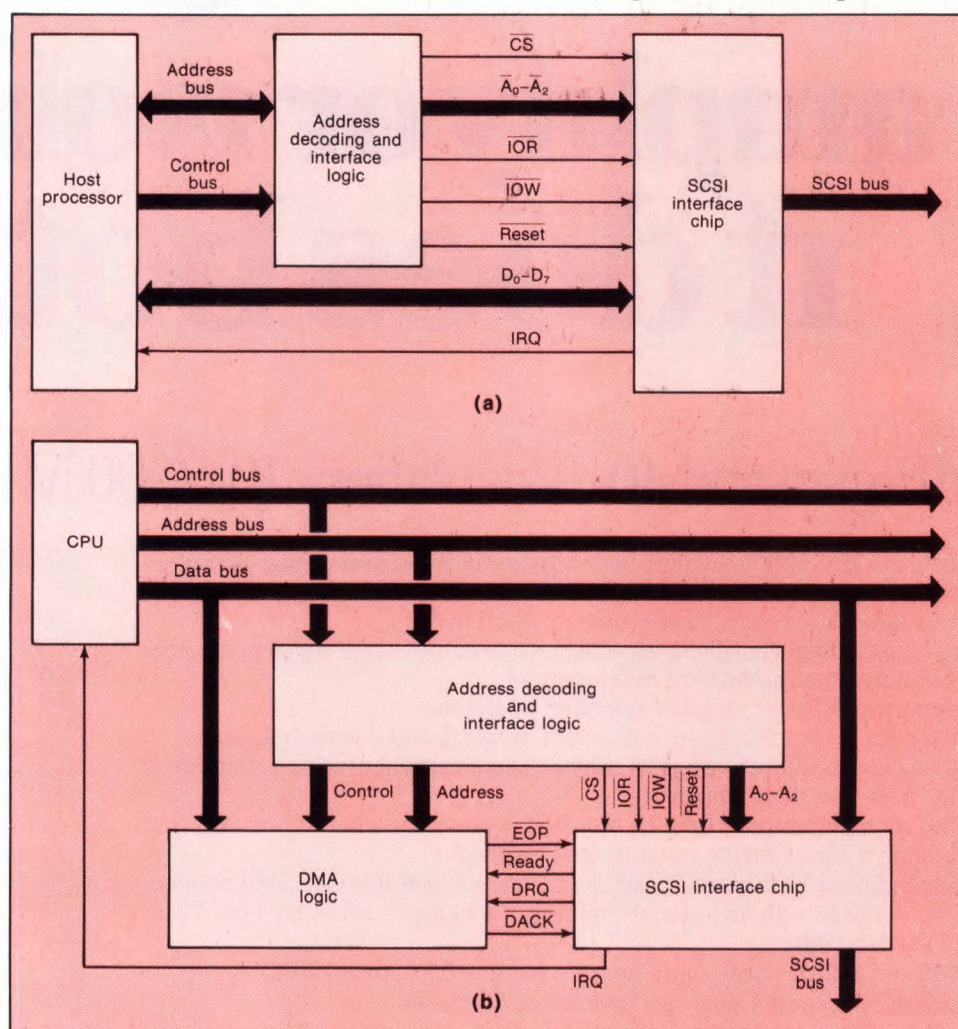
SCSI interface chip

bus (Fig. 2b). This configuration increases the SCSI bus data transfer rate and is useful for a large variety of single- and multitasking systems. For bus management, including I/O bus arbitration, about 1 kbyte of processor instruction code is usually required. The normal DMA cycle can be used even for large block transfers. In operation, the SCSI chip produces a DMA request whenever it is ready for a byte transfer. The host system should respond with a DMA acknowledgment and the appropriate read or write signal.

An intelligent I/O channel, however, will off-load all bus control as well as data transfer

tasks, from the host and thus provide the highest level of system performance. This is equivalent to building an intelligent host adapter for the SCSI bus. To maximize throughput, a dedicated slave microprocessor manages the SCSI I/O channel, and the chip then becomes a peripheral device to this slave processor. For further speed, data can be moved under block-mode DMA control, in which case the block-mode DMA functions are implemented on the controller card, along with the slave processor.

In one typical design using the NCR 6500/II processor, the SCSI bus can be disconnected and reconnected (Fig. 3). The slave processor



2. The 5380 can interface directly with the host processor in a single-user/single-task microcomputer system. In a programmed I/O system, the SCSI chip is mapped into the I/O space of the host processor (a), but adding a DMA channel enhances the interface (b). In either case, the host is responsible for I/O processing.

Solid-state magnetic-bubble memory from Bubbl-tec®

Mass storage that works where disks don't

Q-Bus™ Bubble Systems
emulate DEC® RL02™
RX02™ RX01™ TU58™

VMEbus™
Bubble Systems provide
up to 8 megabytes of mass storage

STDbus
Bubble Systems are
available for 8088, 8085, Z80, 6809

Once upon a time,
computing was done only in nice,
clean places, and a spinning disk could handle
the mass storage job quite nicely.

But, no more. Now computers are down on the factory floor,
up in airplanes and out in the field. For this new world of applications,
you need *solid-state* mass storage, like Bubble-tec magnetic-bubble
memory systems. They can stand up to the dirt, dust, temperature
extremes, shock and vibration that knock out disks.

Bubbl-tec systems provide battery-free non-volatile mass
storage from 32 Kbytes to 8 Mbytes, with extremely fast access
to every data block. And our systems plug directly into your micro-
computer bus—no need for another chassis or power supply.

Since 1979, we've been shipping solid-state mass storage
systems for every popular microcomputer bus,
including Q, MULTI, STD, S-100, VERSA and VME.
In fact we have more systems in the field than
any other bubble-system supplier.

So, if you don't want to contend with disk
deterioration, head crashes, and mechanical break-
downs, contact Bubbl-tec. Our mass storage
solutions have a solid foundation.

 **Bubbl-tec®**
Division of PC/M Inc.

DEXPO®
West 84
BOOTH
1306

6800 Sierra Court, Dublin, California 94568
Telephone: 415/829-8700 • TWX/Telex: 910/389-6890

CIRCLE 127

BUBBL-TEC INTERNATIONAL DISTRIBUTORS: West Germany: Scantec GmbH 089-859-8021 • Italy: Telcom 02-4047648 • France: Microel S.A. 6-9070824 • Switzerland: Micro-System-Technik, AG 01-520355 • Norway: HCA Melbye 02-106050 • Sweden: TH Elektronik AB 08-362970 • South Africa: Electronic Building Elements PTY, Ltd 12-46-9221/7

Bubbl-tec is a registered trademark of PC/M, Inc. • DEC is a registered trademark of Digital Equipment Corp. • MULTibus is a registered trademark of Intel Corp. Q-Bus, RL02, RX02, RX01, TU58 are trademarks of Digital Equipment Corp. • VERSAbus and VMEbus are trademarks of Motorola, Inc.

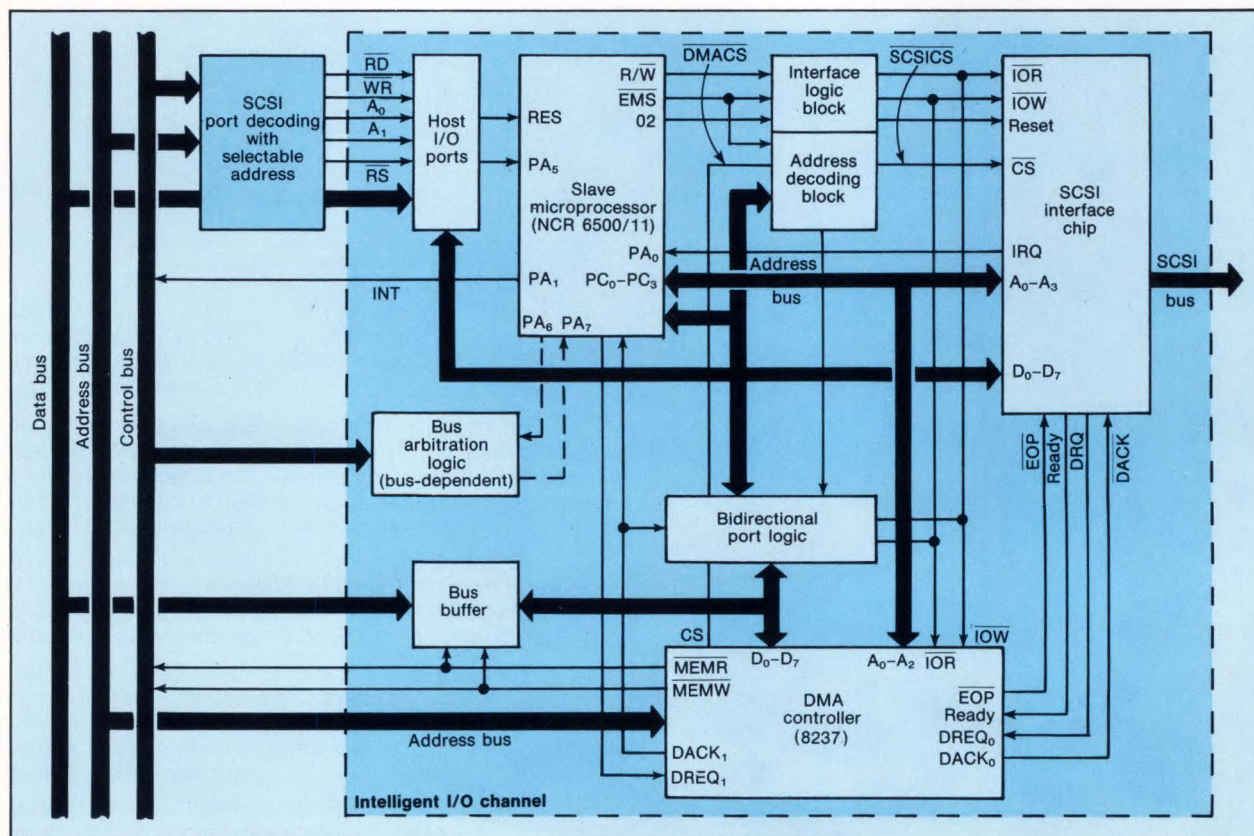
SCSI interface chip

supports the peripheral devices' ability to disconnect themselves and reselect the initiator. It does so by maintaining two sets of pointers, current and saved. Current pointer values indicate the next command, status, or data byte to be transferred between the host and the peripheral device connected on the SCSI bus. Saved pointer values reflect the starting memory address of the command, status, and data blocks in the host's memory.

If an error message or other fault condition forces the I/O processor to repeat the operation, the saved values provide a record of the commands being acted upon and the data being transferred. The command and status pointers,

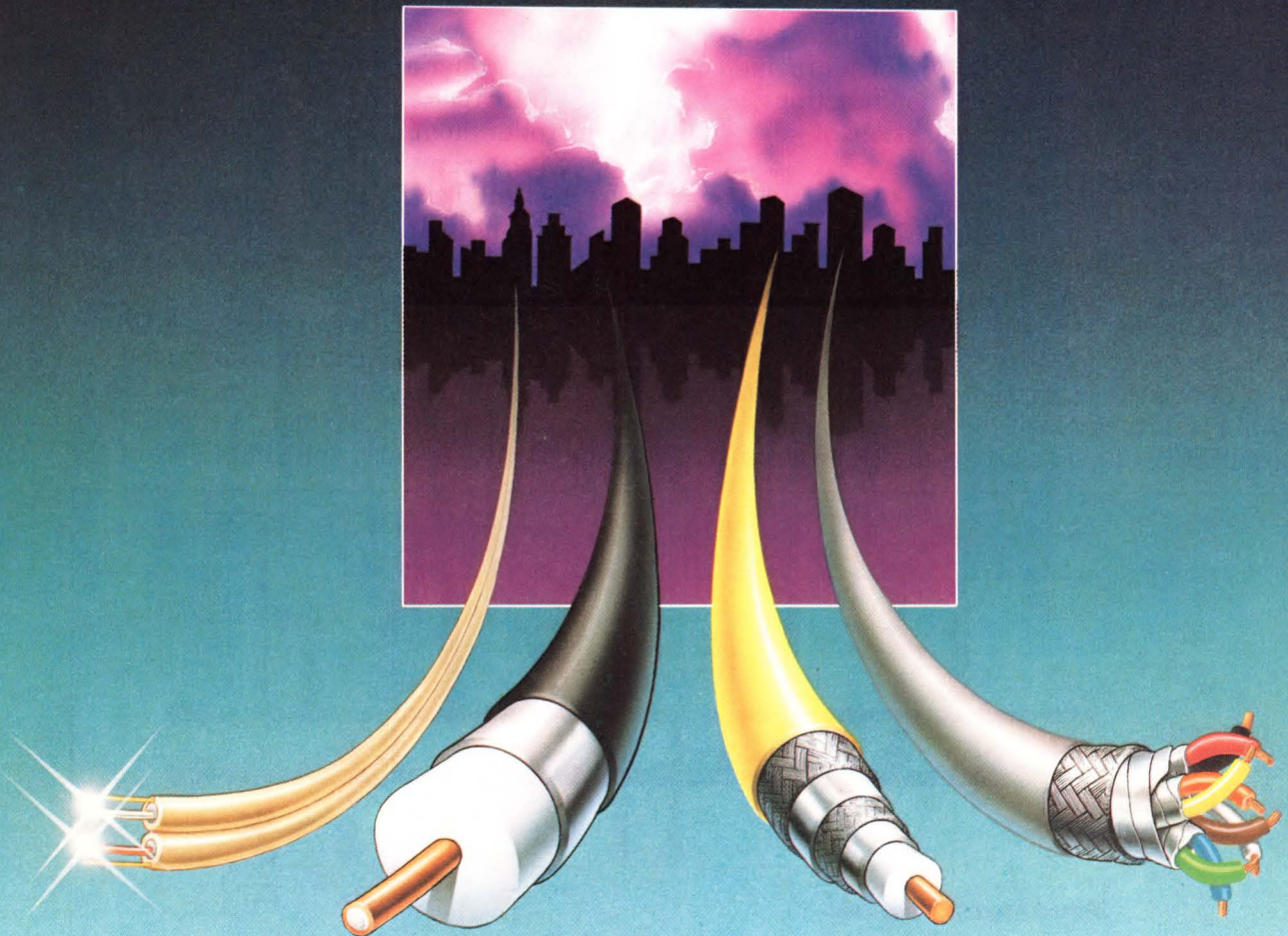
consequently, maintain their initial values until the SCSI transfer operation is completed. The data pointer, however, is periodically updated to the current pointer value as each specified data block is transferred. The updating occurs whenever the slave processor receives a Save Data Pointer message from the attached target device.

Since the I/O channel processor may begin several activities on the SCSI bus at the same time, it must maintain saved pointer values for all logical pathways that have been established between the host adapter and the devices on the bus. The number of logical paths, or "threads," will depend on the design of the I/O channel,



3. The SCSI chip plus an I/O processor creates an intelligent I/O channel system that offloads all peripheral communication and data transfer tasks from the host. The processor maintains two sets of pointers that enable it to connect and reconnect devices to the SCSI bus.

Your LAN connection.



TFC HAS THE BROADEST AND MOST SOPHISTICATED LINE OF COAX AND FIBER OPTIC CABLES AVAILABLE ANYWHERE.

Whether you are planning a Local Area Network (LAN) or upgrading one, Times Fiber Communications has the cable you need. Baseband, broadband, twisted pair, and fiber optic cable and assemblies specifically designed for LANs.

For broadband systems, consider our new T4 PLUS™ cable. It is totally bonded from conductor to jacket, and can be bent to a 4" radius without kinking or flattening. *Unique.*

Considering Ethernet*? Times Fiber Communications has supplied more Ethernet cable than any other company in the world.

If you need help in making the right choice for your needs, our 35 years of experience is yours for the

asking. After you choose TFC, you also get fast delivery from one of our widespread distribution centers, along with the most respected technical back-up in the industry.

Call or write for our complete "Cables for Electronic Data Processing" catalog. If you are interested in specifically designed cable for your LAN, contact John Palasciano, Marketing Manager, LAN Products, Times Fiber Communications, Inc., 358 Hall Avenue, P.O. Box 384, Wallingford, CT 06492, (203) 265-8439 or (800) 243-6904. *A trademark of Xerox Corporation.



TIMES FIBER COMMUNICATIONS, INC.

RF CABLE PRODUCTS DIVISION
358 Hall Ave. • P.O. Box 384 • Wallingford, CT 06492

CIRCLE 602

See us at the Wescon Show - Booth Nos. 2245 & 2247.

SCSI interface chip

but they will require a pointer stack deep enough to accommodate all possible data transfers and operations moving through the channel at any moment. In multitasking environments, these operations will often include printing and data communication functions, as well as disk read and write operations.

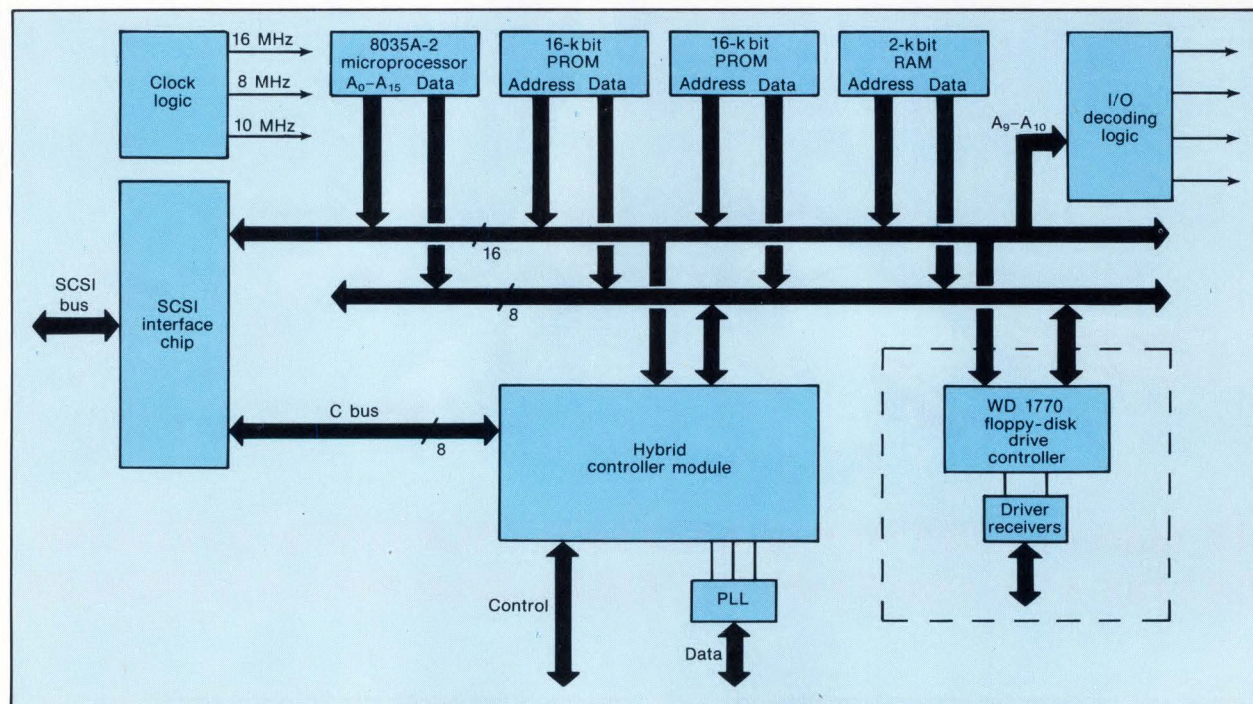
Controller flexibility, too

On the controller side of the SCSI bus, the same kinds of interface possibilities—programmed I/O, DMA, and intelligent interface—are available. Of the three, the DMA interface is nearly mandatory for most device controller applications. On the one hand, it is hard to achieve data rates of more than 50 kbits/s with the SCSI chip in a programmed I/O mode.

On the other, a dedicated processor is rarely needed to control the SCSI channel, because the job is within the capacity of the peripheral device controller.

A disk controller application might use both the SCSI interface chip and the NCR ADP-40 disk controller module (Fig. 4). With these two components, a complete hard-disk controller can be designed to fit on less than 25 in.² of board space, indicating that SCSI controllers may be integrated directly into even the smallest disk and tape peripherals.

The many advantages of this intelligent interface approach—including improved on-board defect management, elimination of redundant drive interface logic, support for a high data transfer rate, and simplicity of the



4. The SCSI interface controller will also manage bus exchanges on an intelligent peripheral, such as a disk storage controller. The NCR 5380 must be programmed as the target in these applications.

The MTX512 opens up to endless OEM possibilities.

Until now, micros meant limitations. In hardware. In performance. And in OEM applications. But the new Z-80A based MTX512 micro computer opens up a whole new world of applications for OEMs. Because it gives you power and flexibility no micro has ever given you before. Especially when you consider the base price—under \$600 retail.

A designer's dream

The MTX512 will surprise you with its standard features. 16 color high resolution graphics. 8 simultaneous windows. Cartridge ports for up to 4MB ROM, pageable in 32KB increments. An uncommitted parallel port. Centronics parallel printer port. Monitor, RF, hi-fi and cassette ports. Plus 104KB of memory—including 64KB user RAM—expandable to 512KB through user-transparent memory segmentation. But don't stop there. The MTX512's open architecture lets you customize to your own needs. Internal expansion slots let you add twin RS232C ports, plus your own custom boards. Optional floppy, hard disk or silicon disk drives provide storage up to 160 MB. You can even connect up to 256 units together in our Oxford Ring—Local Area Network (LAN).

CIRCLE 129

Simplify your development with interacting languages.

Developing software couldn't be more simple. Embedded in ROM are MTX BASIC and MTX GRAPHICS, incorporating LOGO-type commands. MTX NODDY, a simple 11 command text language. Symbolic ASSEMBLER/DISASSEMBLER. And a front panel debugging tool. All 5 can be used interactively and coherently, giving you unprecedented flexibility.

Add disk drives, and the MTX512 runs CP/M* allowing you to choose from the world's largest library of software.

Quality components for added reliability.

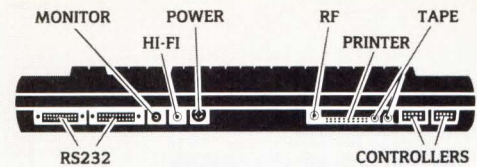
When you use computers in your applications, assurance in quality and performance is essential. The MTX512 is designed around proven components, like the Zilog Z80A (running at

4 MHz) and the TI 9928 video processor. All housed in an anodized aluminum case, which not only provides extraordinary durability, but heat dissipation and RF protection as well.

The MTX512's applications are as expansive as your imagination.

Contact us today for more information.
USA: Memotech Corporation, 99 Cabot Street, Needham, MA 02194 617-449-6614
Europe: Memotech Limited, Station Lane, Witney, Oxon. OX8 6BX, England.

MEMOTECH



*CP/M is a registered trademark of Digital Research Inc.

SCSI interface chip

host interface logic—may well eliminate the need for a separate disk drive controller and disk motor-and-head drive card.

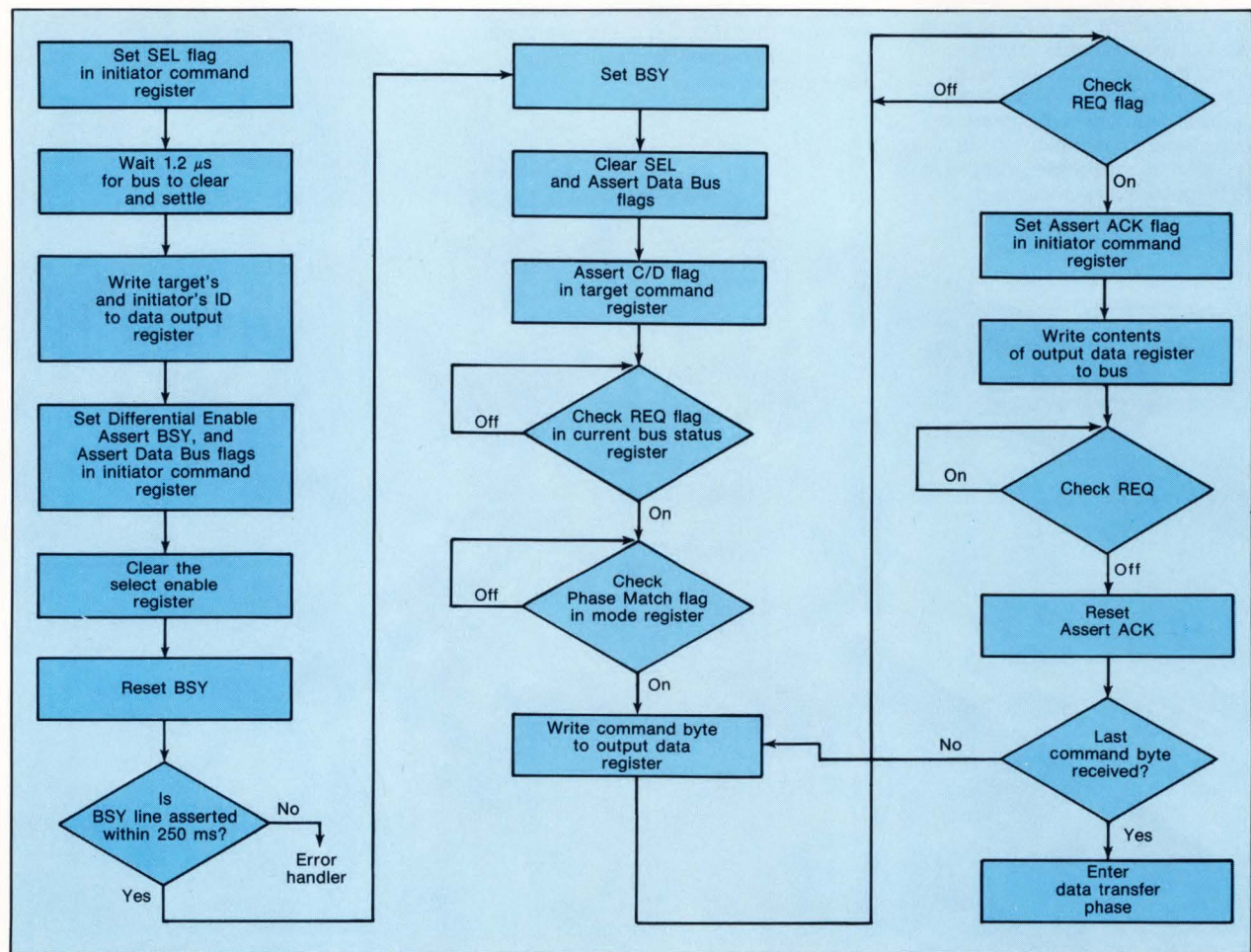
A simple software driver

It is simple to program the SCSI interface chip to serve as an initiator in a single-user, single-tasking system. Such a system can ignore the operational phase involving arbitration for the SCSI bus. It is also assumed that the target device does not support messages and therefore cannot disconnect itself from the

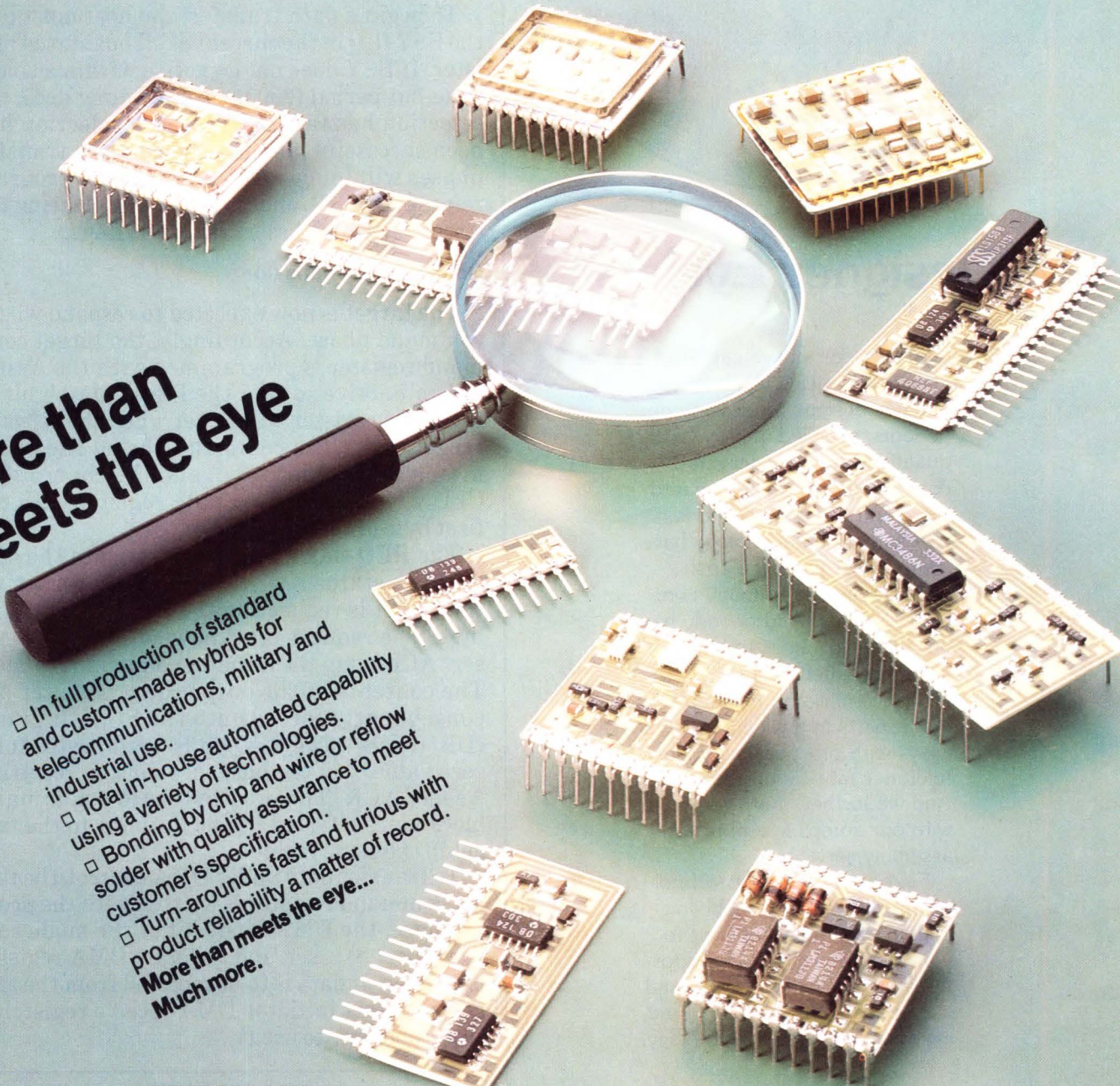
bus. That leaves only the selection, command, and data phases to be programmed.

For the selection phase, the software should first sequence the SCSI bus properly by setting the Assert Data Bus flag and the Assert BSY flag of the initiator command register, clearing the select enable register, releasing BSY, and pausing for a bus settling time of 400 ns. Selection then proceeds with the programming of a logic 1 as the Assert SEL flag of the initiator command register (Fig. 5).

The initiator now waits for the bus to clear



5. Target selection requires the initiator's 5330 to assert a need to use the bus and to wait for the target's response before data transfers can proceed. The entire process is controlled and monitored by the activity of particular bits within the chip's internal registers.



More than meets the eye

- In full production of standard and custom-made hybrids for telecommunications, military and industrial use.
 - Total in-house automated capability using a variety of technologies.
 - Bonding by chip and wire or reflow solder with quality assurance to meet customer's specification.
 - Turn-around is fast and furious with product reliability a matter of record.
- More than meets the eye...
Much more.**

TADIRAN

Electronic Industries, Inc.

350 5th Ave. New York N.Y. 10118, U.S.A. Telephone: 212-947-4600

Lakeland Plaza Professional Bldg., Suite 263 Lewisville TX 75067, U.S.A.

Telephone: 214-221-7523

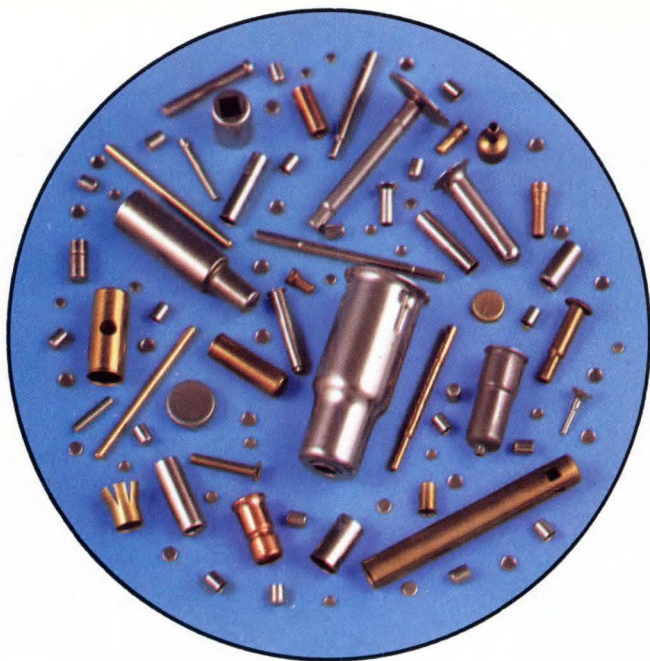
6312 Varrel Ave. Suite 203, Woodland Hills, CA 91367, U.S.A.

Telephone: 213-884-3884. TLX W.U. 705384.

CIRCLE 130

TADIRAN

11, Ben-Gurion Street, Givat-Shmuel, P.O.B. 648, Tel-Aviv 61006, Israel, Telex: 341692, Telephone: 03-713111



Designer Eyelets

Eyelet parts have captured designers' fancies. And not just in fancy designs. Precision components, supplied in large quantities at lower delivered cost, are finding their way into more and more applications.

Advances in technology have made eyelet parts the cost-effective answer to many component needs. And nobody has put these advances to better use than Utitec. We can produce small and miniature eyelet parts in a wide variety of alloys with practically any close tolerance fabrication required. And we further lower your costs with our complete automated assembly service.

Find out how eyelet technology from Utitec can help you find an economical answer to your design problem. Send for the Utitec design brochure and keep pace with today's expanding miniature eyelet technology.



utitec, inc.

1058 Wolcott St., Waterbury, CT 06705
203/575-0090
...a UTI Company

CIRCLE 134

DESIGN ENTRY

SCSI interface chip

(800 ns) and settle before asserting any other bus signals. After the brief delay, the target device's ID—and the initiator's ID, as an option—is asserted on the SCSI data bus. (Asserting the initiator's ID lets the target know which device is selecting it.)

To begin a data transfer, the host must poll the BSY flag in the current SCSI bus status register. If BSY does not go active within a select time-out period (250 ms is recommended), the selection has failed. Otherwise selection has been successful, and the information transfer phases will follow. At this point, the program releases the SEL and the ID bits by clearing the Assert SEL and Assert Data Bus flags.

Commanding behavior

The target is now expected to respond with a command phase. Accordingly, the target command register is programmed with the Assert C/D bit active so that the Phase Match bit in the mode register will be set when the selected target requests a command phase. The phase match is then detected, and the controlling CPU writes the output data register with the first byte of the command block.

The REQ flag is then monitored in the current bus status register. When it goes active, the target is requesting the current command byte. The request is acknowledged by the Assert ACK bit in the initiator command register. The contents of the output data register are consequently forced onto the SCSI data bus (DB₀ to DB₇). The REQ bit is again tested for a zero value, and the host responds by resetting Assert ACK. The next byte of the command block is transferred by the initiator to the target in the same fashion.

To transfer data under DMA control, the target command register is written with the proper phase, the DMA Mode bit of the mode register (port 2) is set, and the start DMA register is written. If data is to be received from the target, the start initiator DMA receive register is the proper one to use. □

How useful?

Circle

Immediate design application	550
Within the next year	551
Not applicable	552

Make room for a new assistant.



Introducing the IBM PC Engineering/Scientific Series.

It puts answers on your desktop.

The IBM Personal Computer Engineering/Scientific Series is an unusually flexible and talented assistant.

As you can see from the box on the right, you can select exactly the workstation you need from a set of compatible engineering and scientific enhancements to the IBM Personal Computer Family. Configure an IBM Personal Computer to help with product design, perform numerical analysis, or monitor and control laboratory experiments.

For the reasonable cost of IBM PC/ES Series enhancements to an IBM Personal Computer, you can do jobs that traditionally demanded time on a mainframe. Display data and plot results as they happen. Control both the business and technical sides of your job from one compact workstation.

And if you want host or networking communications, the IBM Personal Computer has the right connections.

Advanced color graphics.

The IBM PC/ES Series is designed to make a graphic impression in jobs ranging from computer aided design applications and image processing to business presentations.

The IBM PC Professional Graphics Display can make even good results look better with a 640 x 480 screen and up to 256 simultaneous colors available from a palette of 4,096. An advanced anti-glare screen makes the Professional Graphics Display easy to work with and easy on your eyes.

The IBM PC Professional Graphics Controller's onboard 8088 processor can help improve productivity by speeding throughput of even the most sophisticated graphics projects. The graphics firmware support, resident on the adapter, includes 2D and 3D graphics primitives, programmable display lists, and a definable character set to help make your graphics work more creative.

And there's an emulation mode that gives you immediate access to the entire range of graphics programs already written for the IBM Personal Computer.

Productive programming environment.

IBM PC/ES Series layered graphics software is geared for increased programming productivity.

It supports a 32K x 32K addressable point data base, and includes high-level graphics subroutines that are consistent with the Draft ISO and ANSI GKS Standards.

The IBM PC Graphics Development Toolkit provides a device-independent programming environment to help simplify graphics programming tasks. Device independence also helps promote program longevity, since your graphics applications can be programmed to interface with future generations of graphics devices.



*IBM Personal Computer AT with
Engineering/Scientific Series
components.*

Precise high-speed computation.

IBM PC Professional FORTRAN by Ryan-McFarland Corporation—a full ANSI 77 implementation plus enhancements—gives your applications optimized performance on the IBM Personal Computer.

Professional FORTRAN helps you get precise results when you want them, without unnecessary use of valuable mainframe time.

It enables you to begin work immediately on large or small host programs or to recompile existing FORTRAN programs to run on an IBM PC with Engineering/Scientific enhancements. And Professional FORTRAN allows you to utilize all the IBM PC/ES Series graphics development tools in your desktop application work.

Accurate instrumentation.

The IBM PC/ES Series gives you a single point of control for a laboratory full of work.

You can control and monitor laboratory or industrial processes, automated electronic testing, and the status of ongoing experiments via the IBM PC Data Acquisition and Control Adapter. Programming support provides flexible high-level and low-level language interfaces. Powerful built-in diagnostics make installation of the Data Acquisition and Control Adapter quick and easy.

A single half-size IBM PC General Purpose Interface Bus Adapter lets you interactively control instruments as diverse as plotters and spectrum analyzers through application programming. High-level and low-level language access makes it easy to plot and display data. Menu-driven supporting software includes a versatile hardware configurator to aid in installation.



IBM Personal Computer Engineering/Scientific Series Components

Processors

IBM Personal Computer AT
IBM Personal Computer XT
IBM Personal Computer with expansion unit

Color Graphics Hardware

IBM Personal Computer Professional Graphics Display
IBM Personal Computer Professional Graphics Controller

Color Graphics Software

IBM Personal Computer Graphical Kernel System
IBM Personal Computer Graphical File System
IBM Personal Computer Plotting System
IBM Personal Computer Graphics Terminal Emulator
IBM Personal Computer Graphics Development Toolkit

High-Speed Computation

IBM Personal Computer Professional FORTRAN

Instrumentation/Data Acquisition

IBM Personal Computer Data Acquisition and Control Adapter
IBM Personal Computer Data Acquisition and Control Adapter Distribution Panel
IBM Personal Computer Data Acquisition and Control Adapter Programming Support
IBM Personal Computer General Purpose Interface Bus Adapter
IBM Personal Computer General Purpose Interface Bus Adapter Programming Support

Complete the equation.

This assistant is ready to start work immediately. There are over 350 independently developed engineering and scientific application programs—plus many IBM Personal Computer business packages—available today for the affordable IBM PC/ES Series.

For information about the IBM PC Engineering/Scientific Series or to order a catalog of available engineering/scientific programs, see your authorized IBM Personal Computer dealer, IBM Product Center, or IBM marketing representative. For a store near you, call 1-800-447-4700. In Alaska and Hawaii, 1-800-447-0890.

IBM Personal Computer with Expansion Unit and Engineering/Scientific Series components.

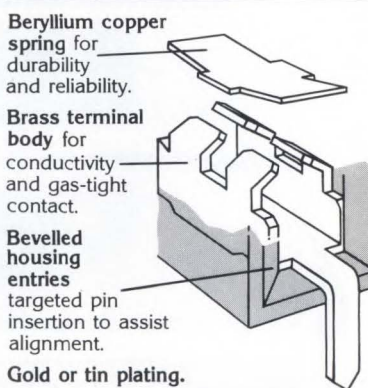
IBM®



Only Berg's card connectors are made with the patented 2-piece dual-metal "PV"[™] receptacle for low contact resistance, lasting retention and exceptional cycle life.

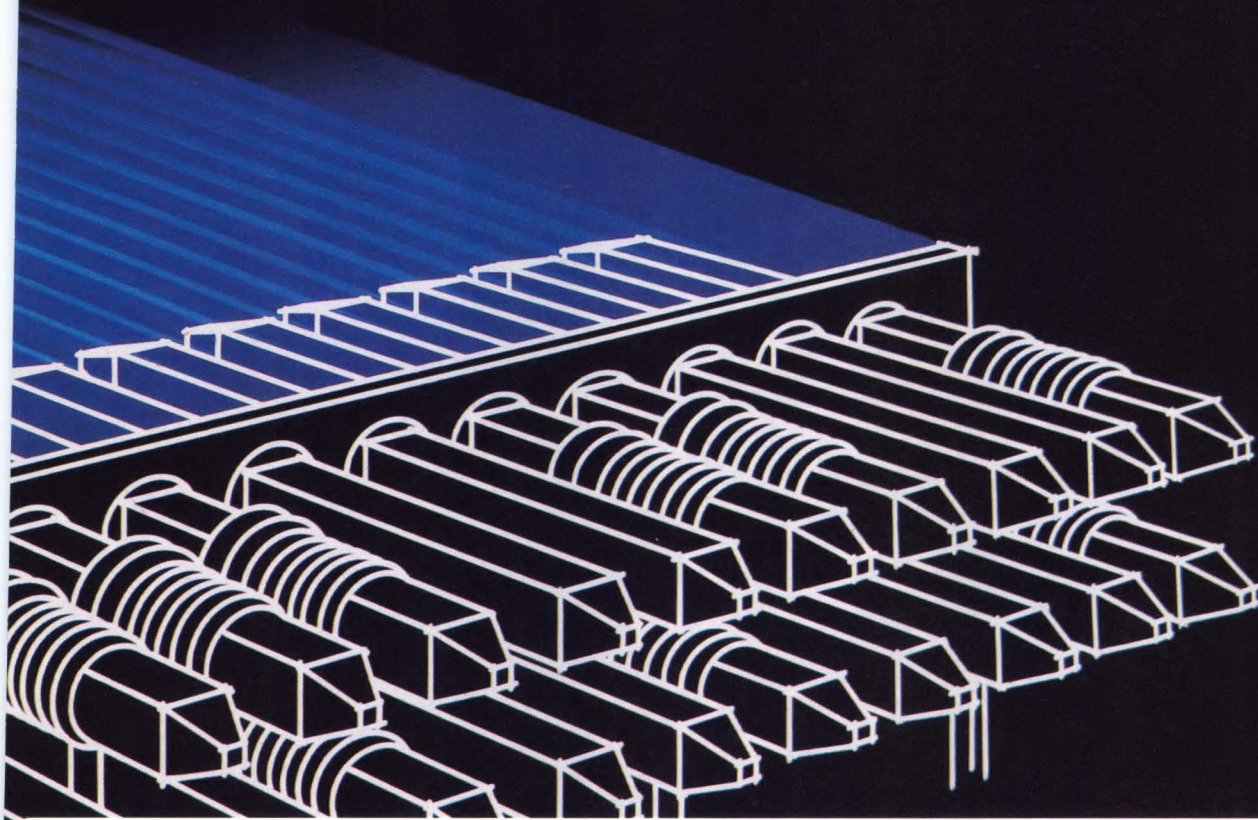
The secret is in the spring. Most female receptacles are stamped from a single strip of metal. The "PV" receptacle is unique: a brass body combined with a heat-treated beryllium copper spring (see the drawing).

Constant mechanical pressure is exerted



on the pins by this all-important spring. And that pressure remains . . . even after repeated cycling. The spring also will absorb stress from a misaligned insertion and continues to apply strong, perpendicular retention force

Berg "PV"™ Card Connectors Make Solid Contact. Over and Over Again.



to the inserted 0.64mm (0.025") square pin.

Excellent electrical conductivity is achieved by the receptacle's high normal force. It creates a wiping action that cleans the contact surface of oxides during insertion and withdrawal. Berg "PV" card connectors come in selectively loaded single and double rows. So you pay only for the positions you need. They conform to MIL C-55302-127/128 and are available for delivery in only 4 to 6 weeks.

Find out more about the Berg "PV" card connector and the entire BergCon system that solves the majority of board-to-board, board-to-wire and wire-to-wire interconnection problems. Berg Electronics, Du Pont Company, 30 Hunter Lane, Camp Hill, PA 17011

For instant information:

**Make the
BERG CONNECTION
Call: 800-237-BERG**

EXTENSION 210

An electronics company.



**A NEW
COMMITMENT
FROM
MOTOROLA**

MOTOROLA QUARTZ CRYSTAL DEVICES ARE NOW AVAILABLE TO ALL OEMs.

This is the news you've been waiting to hear for years.

Reliable Motorola crystal devices offer you design integrity and proven field performance.

For some people, that's all that needs to be said.

Motorola has been recognized for over 20 years as the industry's leading manufacturer of superior products — quartz crystals, temperature-compensated crystal oscillators (TCXOs), monolithic crystal filters, AT-strip crystal resonators, and precision crystal oscillators.

But even if you've heard about Motorola Quartz Crystal Devices, you'll want to know that we're newly committed to serving you. Here's how:

- The most engineering expertise in the design of crystals to critical specifications

- Totally vertical integration in manufacturing to insure quality — from growing our own quartz to hermetically sealing each device
- Quality assurance that includes 100% product testing and Accelerated Life Tests so stringent that they can eliminate many of your incoming inspections
- Responsive delivery and service through multiple domestic manufacturing facilities and a nationwide representative network
- Most of all, unmatched performance reliability and frequency stability in the harshest environmental conditions. Our field return rate is less than 0.2 failures per million hours.

Now that you've heard the news, contact us to find out what it can mean for you and your applications.

Motorola, Inc.
Components Division,
2553 N. Edgington Street,
Franklin Park, IL 60131.
Phone (312) 451-1000
TWX 910-255-4619
Telex 4990104

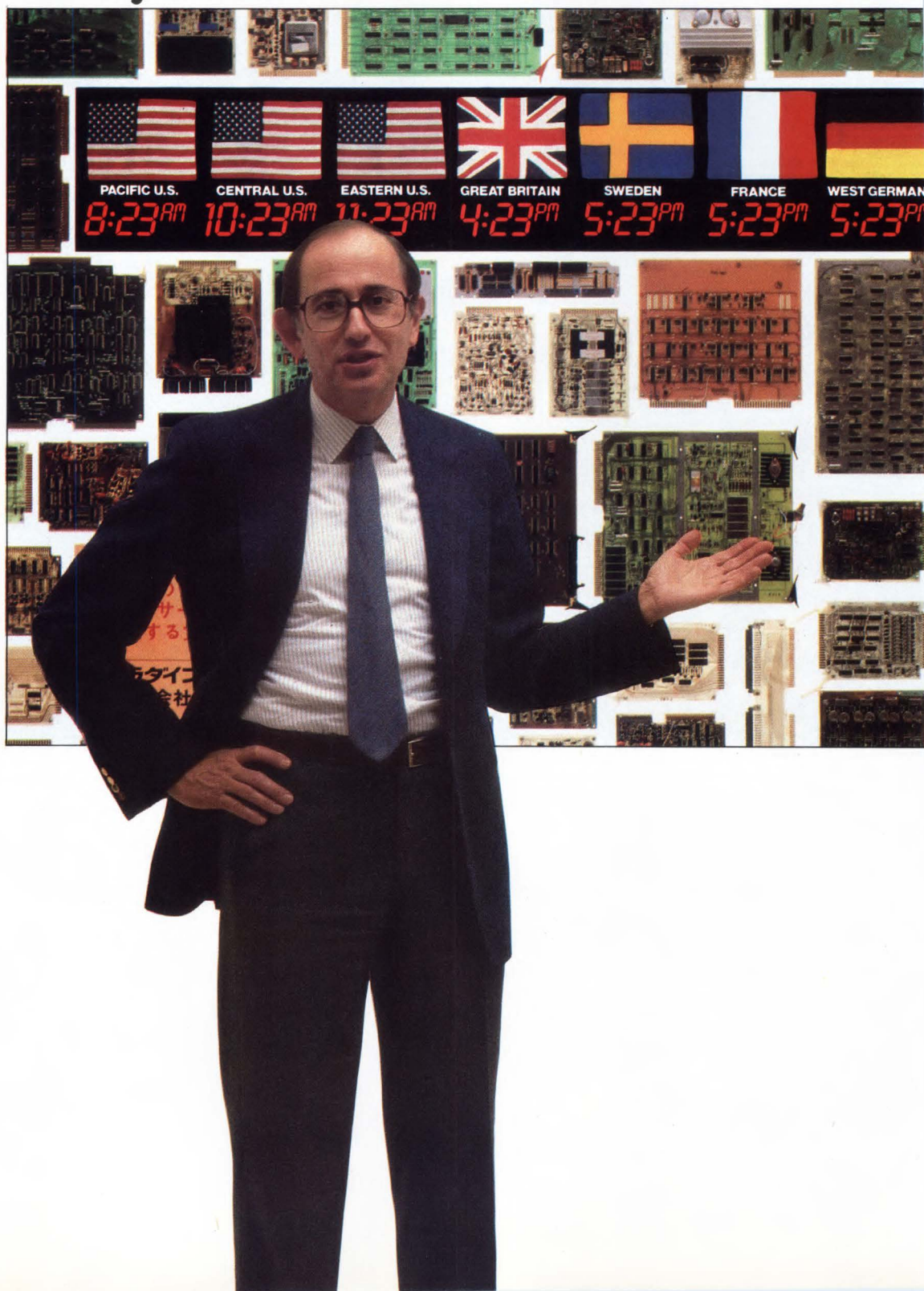


MOTOROLA INC.

Components Division

“Teradyne systems
may occasionally break down.
Teradyne service will not.”

*Alex d'Arbeloff, President
Teradyne*



Nobody likes mistakes. That's why Teradyne has spent more than 20 years building automatic test equipment that roots out and eliminates errors.

Nobody's perfect, however, and in one of life's great ironies, even Teradyne products sometimes fall down on the job. But not to worry. We can be absolutely candid about

this for two reasons. First, we know that within any reasonable framework, Teradyne equipment performs superbly.

Second, when the inevitable problem does occur, we also know that you can't find better service than ours anywhere. And we're very proud of that.

Only Teradyne offers such a variety of service options. For instance, you can contract for complete on-site service to be delivered within a specified time. If we don't come through, you don't pay.

Or you may choose to be more self-reliant, in which case we'll analyze your needs and help train and equip your people to handle almost anything that comes up. You'll go from downtime to uptime in no time.

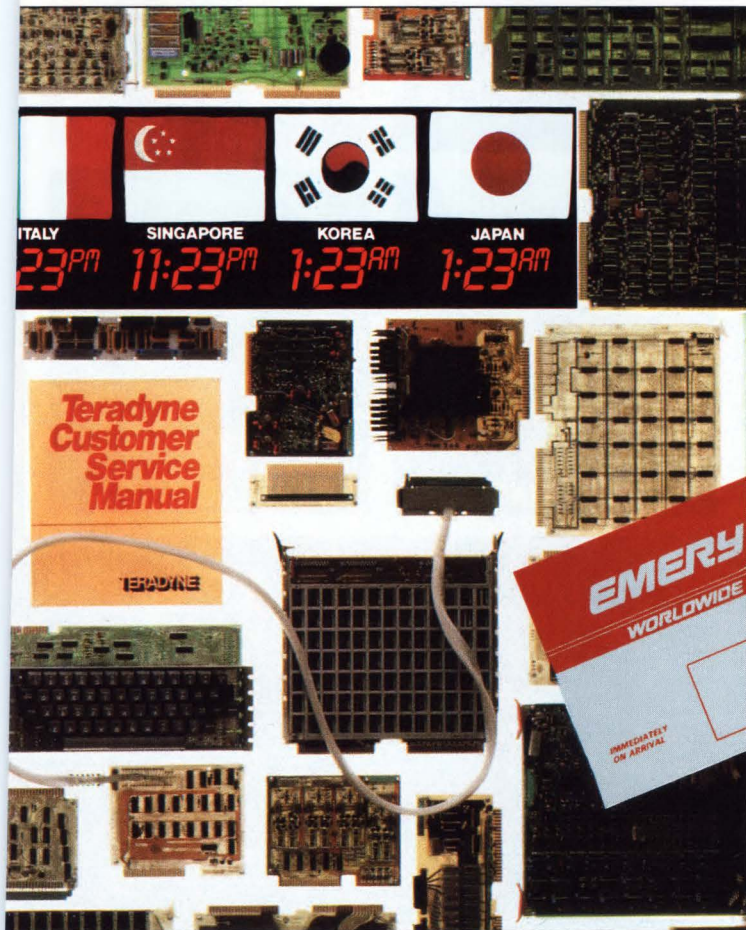
The point is, whichever option you choose, we'll give you all the support you need. And in this unpredictable world that kind of assurance can be very comforting.

So there you have it. Admitting we're not perfect may be a bit unusual, but then at Teradyne we never follow the pack.

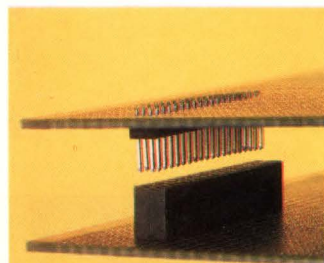
We lead it.

TERADYNE

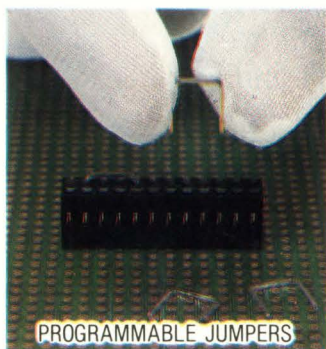
We measure quality



PUT IT ALL TOGETHER WITH METHODE'S POST/BOXE CONNECTORS!



VERTICAL
BOARD-TO-BOARD



PROGRAMMABLE JUMPERS



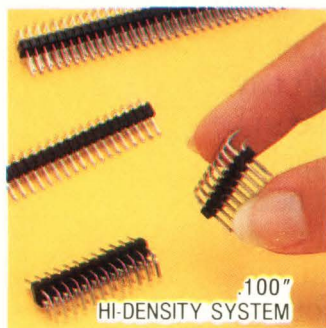
WIRE-TO-BOARD



PROGRAMMABLE SHUNTS



HORIZONTAL CARD-EDGE



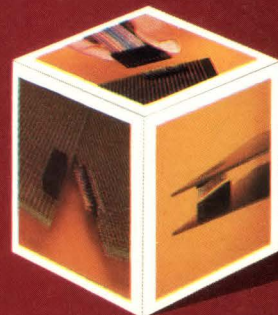
.100"
HI-DENSITY SYSTEM

Our new Post/Boxe connectors and headers offer reliable, high-density board-to-board or wire-to-board interconnects. Based on a .100" grid, the system includes both horizontal and vertical connector styles for card-edge or stacked usage. And, there's male & female programmable jumpers for fast, in-the-field circuit changes.

FEATURES OF METHODE'S POST BOXE SYSTEM

1. **LOW APPLIED COST** - As compared to card edge types-gold tabs typically add 30% to the cost of a printed circuit board.
2. **HIGH RELIABILITY** - Close tolerance multiple contact surfaces.
3. **LOW MATING FORCES** - As compared to card edge types which normally have to handle .054" to .070" thickness tolerances.
4. **INCREASED DENSITY AND FLEXIBILITY** - Two piece connectors can be arrayed in two rows and provide stackability and more efficient use of space in an enclosure.

From 2-65 (single), or 4-130 (dual) positions are available for high-density applications. Contact rating is 3 amps (250 VAC) and the tin-plated, phosphor bronze contacts may be selectively gold plated. The connector & header housings are rated 94V-0.



METHODE ELECTRONICS, INC.

INTERCONNECT PRODUCTS DIVISION

1700 Hicks Road ■ Rolling Meadows, IL 60008
(312) 392-3500 ■ TWX 910-687-0760

Dynamic RAM controller weds reduced chip count with quick access time

*Its internal delay line and advanced arbitration scheme
let a monolithic controller keep support circuitry
at a minimum and memory access speed at a maximum.*

The typical microprocessor-based system requires a memory of at least 128 kbytes. That demand can be met most economically with RAM, especially using 64-kbit chips. And even further savings are realized if the dynamic RAM controller itself is integrated onto a single IC.

The 8208 dynamic RAM controller is a companion to the iAPX 186 and iAPX 188 microprocessor families. It furnishes a high-performance interface between these CPUs and the memory arrays they work with. The controller's output buffers can drive a 1-Mbyte array (employing 256-kbit dynamic RAMs) without extra dynamic RAM drivers. In fact, the chip holds to a minimum amount of TTL glue logic in the dynamic memory interface of systems built around these microprocessors.

John Vidal and David Perlmutter, Intel Corp.

John Vidal has worked at Intel's Santa Clara division since 1980 and is currently a product manager in software product marketing. Earlier, he served as the product manager for several of Intel's peripheral components, including dynamic RAM controllers. Vidal, who holds a BSEE from California State University and an MSEE and MBA from Stanford University, has also worked at NASA's Ames Research Center and for Memorex.

David Perlmutter is a component design engineer at Intel's design center in Haifa, Israel. He has also been the design engineering liaison for the Israeli and Santa Clara design centers. He holds a BSEE from Technion, the Israel Institute of Technology.

The chip's main functional blocks are an address multiplexer, refresh address counter, timer, refresh/memory cycle arbiter, and dynamic RAM output timing generators (Fig. 1). In what is known as the default configuration the controller is programmed by grounding its Program Data Input (PDI) pin, thus allowing the IC to handle two banks of 64-kbit dynamic RAMs with 150-ns access times. A typical application would have the chip synchronously tied into an iAPX 186 with the microprocessor clock and status lines directly connected to and decoded by the controller (Fig. 2).

New developments

Two novel design techniques are used in the chip. First, an internal state-of-the-art delay line guarantees the accurate timing required of a dynamic RAM interface. (No external delay line is needed to generate the requisite dynamic RAM timing.) Second, an advanced on-chip arbitration scheme speeds accesses to the system's dynamic memory array.

The internal delay line eliminates the need to generate clock edges from a clock source, whether on or off chip, for timing the RAM. Instead, the controller operates with the system microprocessor clock and thus is synchronous with it, eliminating any synchronization that would be required if the design employed asynchronous clocks. Specifically, with the controller one clock cycle is saved that would otherwise

Dynamic RAM controller

be needed to synchronize the command lines (or status lines) from the CPU to the controller.

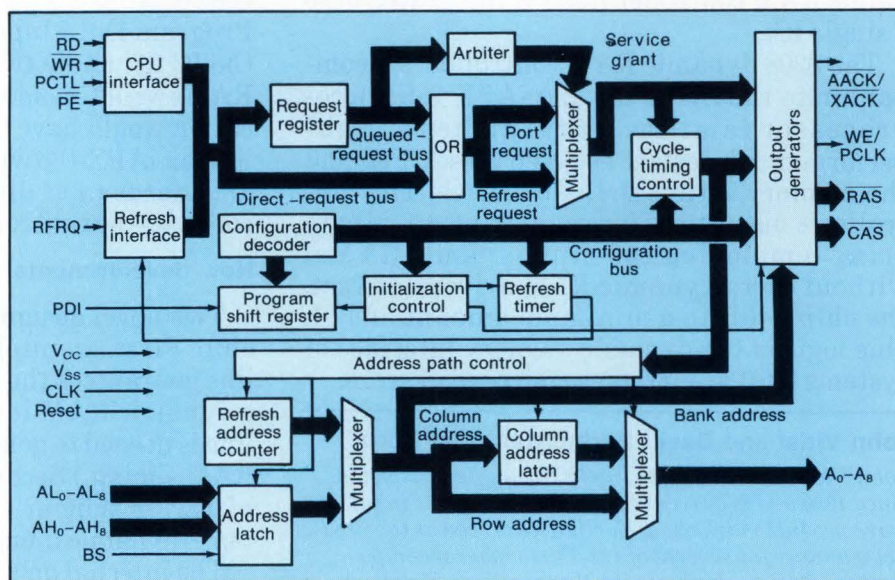
A so-called up-front refresh arbitration scheme ensures quicker accesses and transfers to the dynamic RAM by overlapping the refresh service with a normal memory cycle (Fig. 3). When refreshing is requested during a data access cycle, the refresh address is generated and kept waiting till the current data cycle ends. Thus a refresh cycle begins immediately after a data access cycle is completed. Alternatively, during a refresh cycle a normal RAM cycle is similarly queued, hiding its overhead in the refresh.

At this point, the question of the extra overhead needed by dynamic—rather than static—RAM must be addressed. The choice of one or the other memory hinges on two system requirements: memory size and performance. The greater density of dynamic memory must be weighed against the space and performance overhead exacted by its refresh circuitry. Since the controller handles all the RAM overhead, a dynamic RAM system based on it looks like a

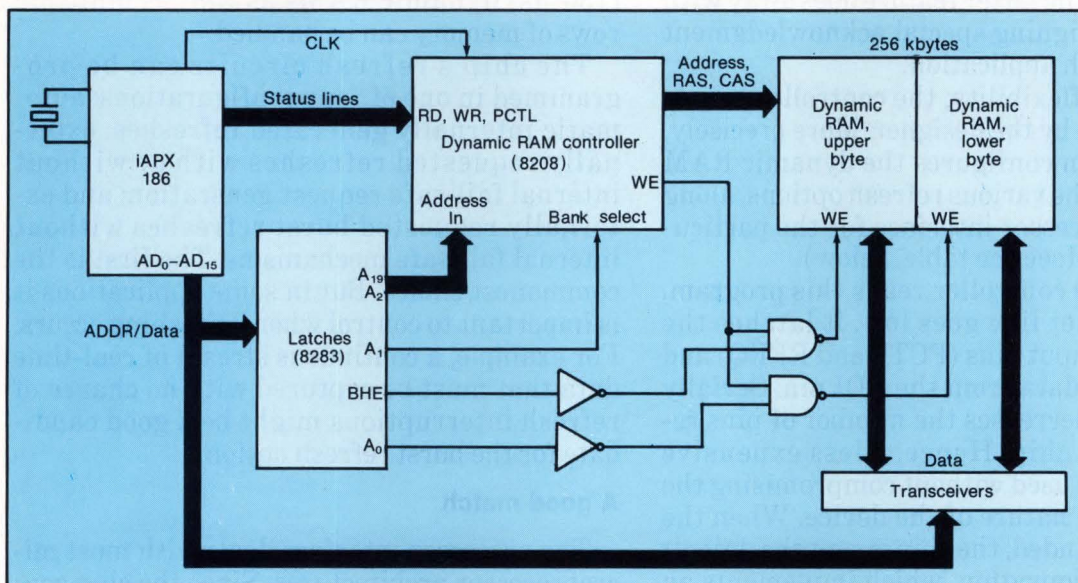
static RAM array to the designer. In fact, projections show that for memory arrays of 64 kbytes or larger, the chip is a cost-effective component.

The RAM controller multiplexes the address bus and issues the appropriate Row Address Strobe (RAS) and Column Address Strobe (CAS) signals. The chip times the row and column addresses as well as the RAS and CAS strobes properly and sends out a Write Enable strobe (WE) with the correct dynamic RAM timing. WE enables the RAM's write circuitry so that data from the microprocessor bus may be stored in the memory array. (Without the controller on duty, a multiplexer, a multitap delay line, and four or five steering-control logic devices would be needed.)

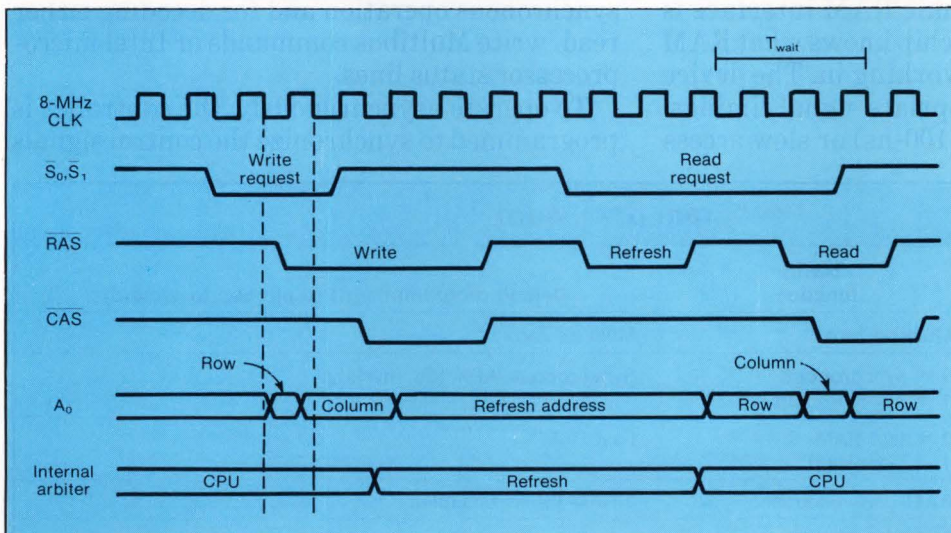
Most dynamic RAM systems need time to warm up before data can be transferred between them and the system bus. These warm-up cycles are automatically furnished by the controller, which also supplies several types of feedback signals to indicate that transfers have taken place and that data is available to the mi-



1. The 8208 dynamic RAM controller is a companion chip to the iAPX 186 and 188 microprocessor families. Its high level of integration means little TTL glue logic is required to complete the interface in a typical application.



2. In a system built around the iAPX 186 and the controller chip, the microprocessor's clock and status lines are directly connected to and decoded by the controller.



3. The back-to-back data access and refresh cycles of a system employing the iAPX 186 and the controller system show that the refresh address is sent to the dynamic RAM array even before the earlier data access write CAS is completed. Similarly, the row address for the next read data cycle is sent immediately after the refresh cycle is completed.

Dynamic RAM controller

croprocessor. The latter feature does away with the task of designing special acknowledgment circuits for each application.

For greater flexibility, the controller chip is programmable by the designer. More precisely, a 9-bit program configures the dynamic RAM interface and the various refresh options, along with microprocessor interface for the particular job at hand (see the table, below).

At reset, the controller reads this program. When the Reset line goes low, it latches the states of two input pins (PCTL and RFRQ) and accepts serial data from the PDI pin. Serially shifting data decreases the number of pins required by the chip. Hence, a less expensive package can be used without compromising the highly flexible nature of the device. When the PDI pin is grounded, the chip is sent the default iAPX 186 configuration, which implements an 8-MHz system that uses 150-ns dynamic RAMs with zero wait states.

The controller's dynamic RAM interface is programmed so that the chip knows what RAM environment it will be working in. The device then produces the appropriate signal timings. In this way, fast access (100-ns) or slow access

(150-ns) dynamic RAMs as well as multiple rows of memory can be handled.

The chip's refresh circuits can be programmed in one of four configurations: automatic internally generated refreshes; externally requested refreshes with or without internal fail-safe request generation; and externally requested burst refreshes without internal fail-safe mechanisms. The first is the commonest choice. But in some applications it is important to control when refreshing occurs. For example, a continuous stream of real-time data that must be captured with no chance of refresh interruptions might be a good candidate for the burst refresh option.

A good match

The processor interface deals with most microprocessor architectures. Since the chip contains the requisite synchronizing and decoding circuitry, it can be tailored for asynchronous or synchronous operation and for decoding either read/write Multibus commands or Intel microprocessor status lines.

To operate asynchronously, the controller is programmed to synchronize the control signals

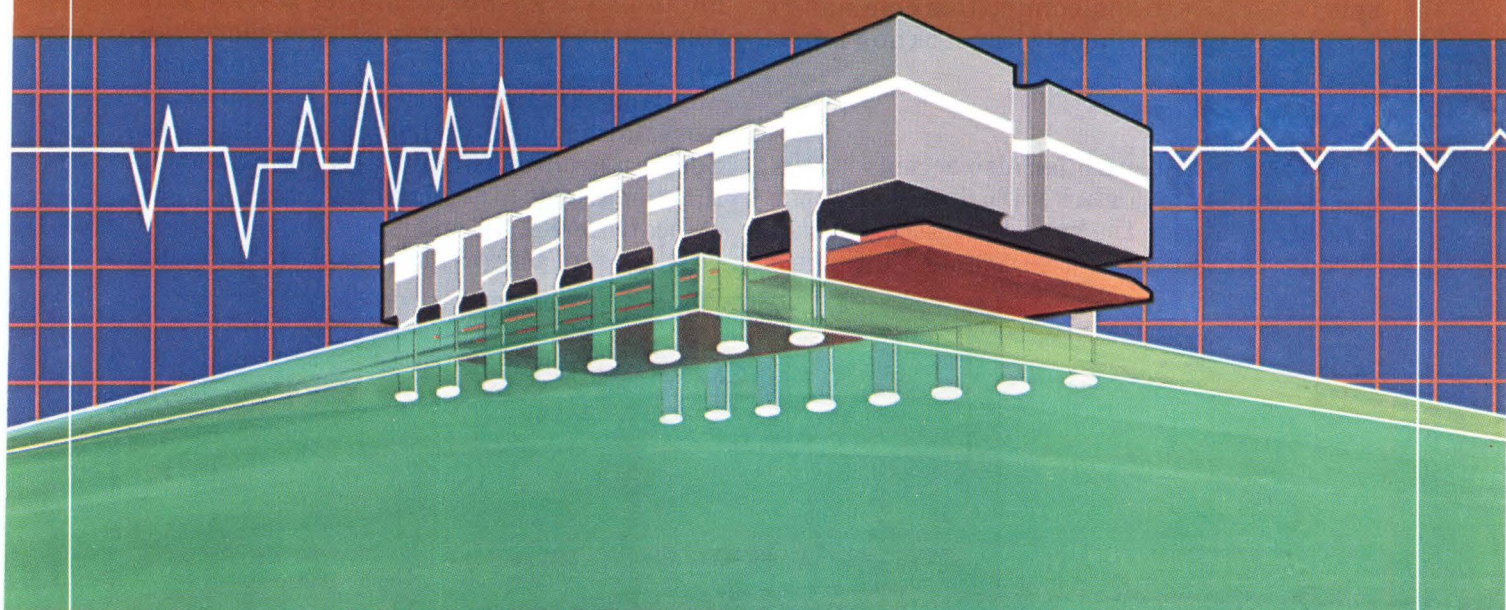
Program data word			
Program data bit	Name	Polarity function	Default programming (PDI pin tied to ground)
PD ₀	CFS	Must be zero	Must be zero
PD ₁	$\bar{S}$	0 = synchronous 1 = asynchronous	Synchronous iAPX 186 interface
PD ₂	$\overline{RFS}$	0 = fast RAM 1 = slow RAM	Fast RAM*
PD ₃	$\overline{RB}$	RAM bank occupancy	2 RAM banks occupied
PD ₄	$\overline{CI_1}$	Count interval bit 1	Refresh interval uses 118 clock pulses
PD ₅	$\overline{CI_0}$	Count interval bit 0	
PD ₆	$\overline{PLS}$	0 = long refresh period 1 = short refresh period	128-row refresh in 2 ms; 256-row refresh in 4 ms
PD ₇	$\overline{FFS}$	0 = fast CPU frequency 1 = slow CPU frequency	Fast processor clock frequency (8 MHz)
PD ₈	$\bar{X}$	0 = $\overline{AACK}$ 1 = $\overline{XACK}$	Advanced ACK strobe

*For iAPX 186 systems either slow or fast (150- or 100-ns) RAMs may be used.

NOW THE SOLUTION TO IC NOISE IS RIGHT UNDER YOUR DIP



INTRODUCING MICRO/Q HIGH-FREQUENCY DECOUPLING CAPACITORS FROM ROGERS.



Rogers' new MICRO/Q™ capacitors get to the root of IC noise problems. Save valuable real estate. And let you increase IC density.

The first flat capacitor with the rectangular dimensions of standard DIP packages, MICRO/Q fits directly under ICs or sockets. Because it shares the same power and ground holes, there's no need to modify regular two-sided or multilayer boards. Use of out-board mounting holes is optional.

Specifically designed to optimize

the performance of today's fast-rise ICs by minimizing noise, the MICRO/Q capacitor's low-inductance design and high-frequency performance can reduce voltage and ground spikes up to 90%.

Available in all standard sizes or custom configurations, its low impedance and overall superior electrical performance will enhance the operation and reliability of virtually any board design. For all the facts, contact a Rogers MICRO/Q Product Specialist today at (602) 967-0624.



ROGERS

Rogers Corporation
Q/PAC Division
2400 South Roosevelt, Tempe, AZ 85282
602 967-0624

Dynamic RAM controller

sent to it by the microprocessor. To minimize the delays involved in synchronizing these signals internally, the controller also changes the timing of its acknowledge output signals. Alternatively, for faster accesses, the designer may choose the synchronous interface, which bypasses the chip's internal synchronizing circuitry.

Any master that is compatible with Multibus can easily link to a dynamic RAM array managed by the controller. Further, the controller can be programmed to respond to Read, Write, and Inhibit (MEMRD, MEMWT, and INH, respectively) Multibus-compatible commands and to supply the necessary Acknowledge (XACK) signal.

In synchrony

However, the controller also accepts status information from an iAPX 186 directly, so that it need never keep the microprocessor waiting. When programmed to do so, the chip initiates a

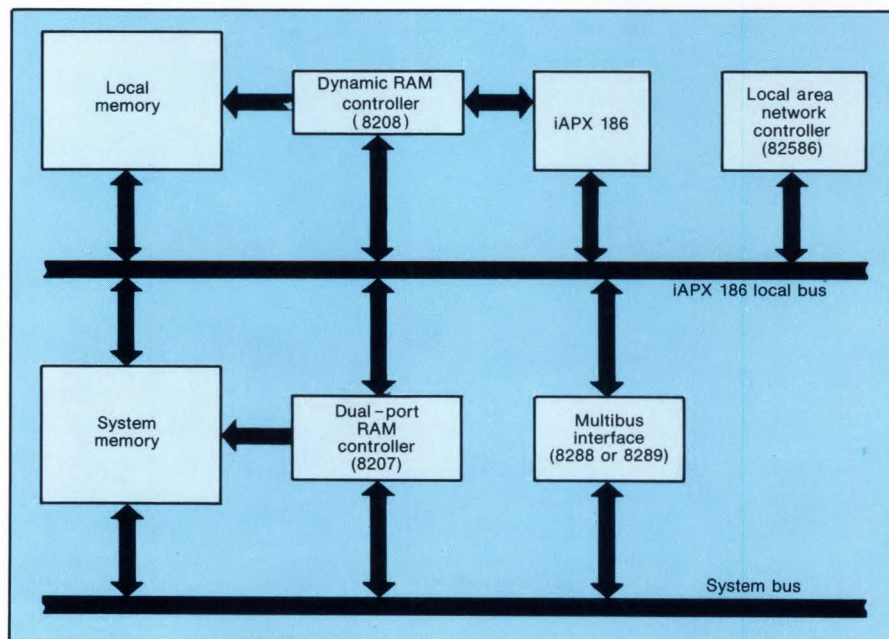
RAM cycle one cycle earlier than when using the CPU's Read or Write lines.

By operating synchronously with the iAPX 186 and decoding the status information, the controller begins memory accesses early enough to have data ready as soon as the CPU needs it. The synchronous interface does away with the synchronizing time for each command input, in turn shortening the memory cycle access time.

At work in a workstation

The dynamic RAM controller would be at home in a high-performance workstation whose main elements are a CPU, memory, video controller, mass-storage unit, and data communications system. For the best results, the workstation employs distributed intelligence. Such an architecture entails analyzing each functional node to determine whether it needs a dedicated iAPX 186 and bus.

The design assigns global tasks to the system



4. In a distributed-intelligence workstation, the communication subsystem can be designed with local intelligence so that the main system bus will not be tied up when the high-bandwidth local network is in use.

CMOS Machine The CMOS Machine The CMOS Machine The CMOS Machine The CMOS Machine The CMOS Machine The CMOS Machine The CMOS Machine The CMOS Machine The CMOS Machine

THE \$4900 DEVELOPMENT STATION.

More than an emulator, the Relms Icebox is an upgradeable, portable development station. For \$25,000 less than you'd pay for a cumbersome development system, you can emulate, program proms, interface to your line printer and upload/download to your host machine.

And, you won't be spending \$30,000 for something that only works on one manufacturer's chip. The icebox works on the popular chips you're likely to be using, including the new CMOS chips.

The Icebox can be easily upgraded to include an editor and a family of assemblers. And, you can take advantage of the compiling power you already have, built into your company's existing computers. The Icebox can communicate with the Intel iPDS and INTELLEC, the DEC PDP-11, VAX, RSX-11 and most CP/M systems—including the Osborne.

Used in conjunction with Relms SPICE (Special Purpose In-Circuit Emulator) the Icebox emulates the:

- Z80A,B,L • 8085 (8 MHz) • 6502
- Z80 (CMOS) • 80C85 (6 MHz) • 65C02
- NSC 800 (2.5 and 4 MHz)



You can buy ten Icebox development stations for the price of one development system. So, the Icebox can be used in the lab to develop systems, in production to debug and test, and for field servicing. This allows R&D, production and field service to coordinate activities when they have a common problem.

The Icebox weighs about 25 pounds, and measures less than 9" x 11" x 17". It includes 256K of emulation RAM, two serial I/O channels for synchronous and asynchronous communications, with RS-232C and RS-422A connectors. And, it's self-diagnostic. Relms also offers a service and technical support contract.

Call a Relms representative in your area for more information or a demonstration.

Relms (Relational Memory Systems, Inc.), 1650-B Berryessa Road, San Jose, CA 95133 (408) 729-3011
TWX: 910-379-0014

Development System	• Compiles • Edits • Interfaces w/printer • Assembles • Programs Proms • Uploads/downloads • Emulates	\$25-50,000
Development Station	• Edits (optional) • Assembles (optional) • Interfaces w/printer • Programs Proms • Uploads/downloads • Emulates	4-11,000
Emulator	• Downloads • Emulates	4-9,000

Dynamic RAM controller

bus and work specific to a functional node to each local bus. An individual node's memory and bandwidth requirements dictate if it should also use dynamic RAM—and hence the controller chip. In this instance, most of the nodes can be modeled similarly, each using a CPU, a local memory, a Multibus port, a local memory controller, and a port into the common system memory.

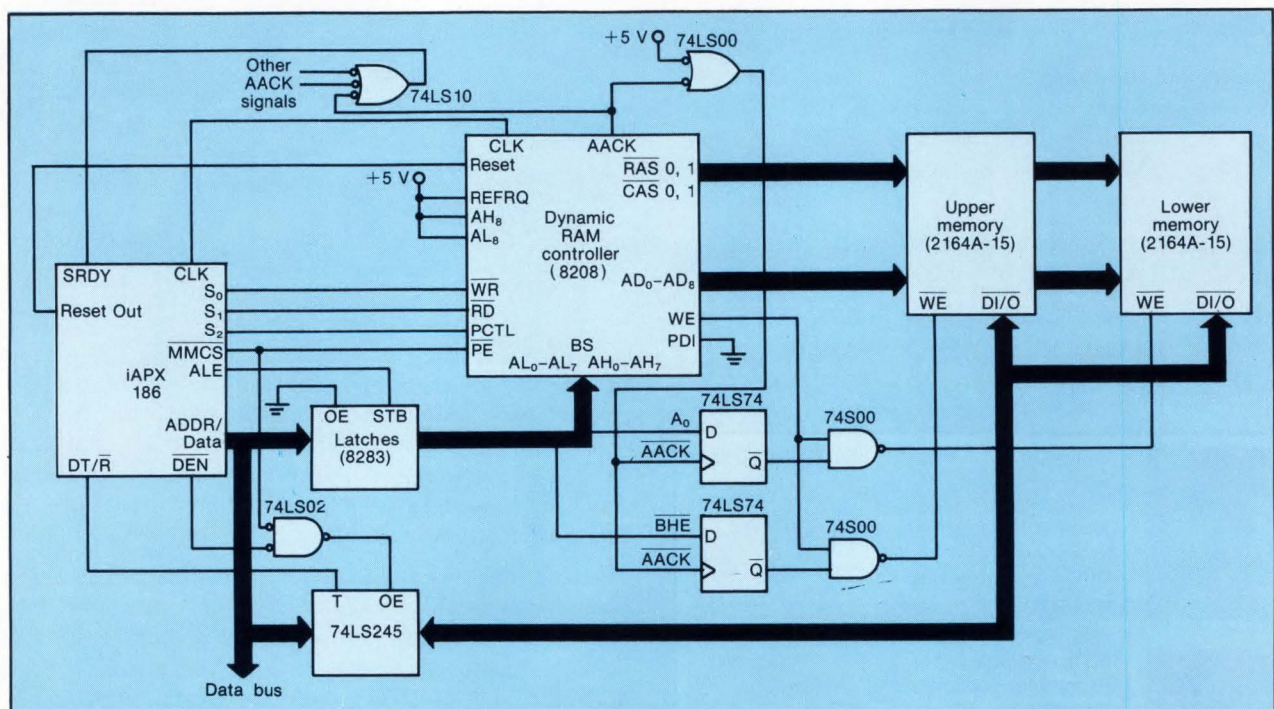
For instance, the workstation's communications subsystem can be designed with local intelligence so that the main system bus is not tied up when the high-bandwidth local-area network is in use (Fig. 4). The network operates in an isolated or local environment and eventually communicates with the main system through the Multibus port or through the dual-port memory.

Communications between the main processor and the local subsystem take place

through the shared system memory. An 8207 dual-port memory controller connects the local iAPX 186 bus to the main processor bus. Separating the buses in that way enables high-bus-bandwidth peripherals to run simultaneously with the system processor, improving the overall system bandwidth. And with an iAPX 186 processor at each node, information can be pre-processed before being sent to the main CPU.

Timing counts

The hardware interface between the iAPX 186 and the controller is common to most of the functional nodes used in the workstation (Fig. 5). For every local processing element a goal of zero wait states was established. Several timing concerns should be addressed when planning this type of system, including setup and hold times for commands, addresses, CPU acknowledgments, and writes. Further, a read-



5. The hardware interface between the controller and the iAPX 186 is common to many functional nodes within the workstation. All local processing was designed with a zero wait-state goal.

HARRIS SPECTRUM



Announcing New Harris Low Noise Op Amp Series:

Performance that's truly sensational!

Clean up your most demanding signal conditioning and instrumentation circuits.

Replace your existing dual and quad op amps with pin-compatible Harris Low Noise Op Amps—the new ones with lower noise and higher performance!

They're available now in four great models with wide bandwidths and high slew rates (see table). And with exceptionally low noise—only $4.3 \text{ nV}/\sqrt{\text{Hz}}$ at 1 kHz !

Their input specs are every bit as impressive. Ready? A mere 2 mV offset voltage and 30 nA offset current. Very modest power consumption ($90 \text{ mW}/\text{package}$ for duals; just $150 \text{ mW}/\text{package}$ for quads). And operation from a single $+5\text{V}$ supply, if you want.

Put the low noise and high signal purity characteristics of new Harris Low Noise Op Amps to work in your most demanding circuits—audio amplifiers, active

filters, instrumentation amplifiers, integrators, signal generators, or what have you. Here's what we have:

Harris Low Noise Op Amps Product Summary

Part Number	HA-5102	HA-5104	HA-5112	HA-5114
Configuration	Dual	Quad	Dual	Quad
Slew Rate	$4\text{V}/\mu\text{s}$	$4\text{V}/\mu\text{s}$	$20\text{V}/\mu\text{s}$	$20\text{V}/\mu\text{s}$
Bandwidth	8 MHz	8 MHz	60 MHz^*	60 MHz^*
Voltage Noise	$4.3 \text{ nV}/\sqrt{\text{Hz}}$	$4.3 \text{ nV}/\sqrt{\text{Hz}}$	$4.3 \text{ nV}/\sqrt{\text{Hz}}$	$4.3 \text{ nV}/\sqrt{\text{Hz}}$

*Uncompensated (Minimum closed loop gain of 10)

For your information, our name is Harris.

For more information, write: Harris Semiconductor Analog Products Division, P. O. Box 883, MS 53-035, Melbourne, Florida 32902-0883.

Harris Semiconductor Sector: Analog • Bipolar Digital • CMOS Digital • Gallium Arsenide • Semicustom • Custom
CIRCLE 99

*Harris Technology
...Your Competitive Edge*



HARRIS

Visit us at the Wescon Show in Anaheim, CA, Oct. 30–Nov. 1 at the Hamilton/Avnet Booth #3680.

Visit us at the Electronica Show in Munich, West Germany, Nov. 13–17 at the Harris-MHS Booth #19A8, Hall 19.

Dynamic RAM controller

data access margin for the system should be designed in. Good timing margins for all the setup and hold times are critical.

The command setup-and-hold margin is crucial. Without it an instruction from the CPU to the memory system could go unrecognized and hang up the system by sending the CPU into an endless series of wait states. Two events must occur for the controller to recognize a valid memory command. The iAPX 186 status outputs must be sampled by a rising clock edge (the middle of the first microprocessor's clock cycle) and the chip's Port Enable input (PE) must be sampled on the very next falling clock edge. Both signals need to be sampled with the appropriate setup and hold times. If PE is not sampled at this point, no memory cycle will start and the status lines would have to go inactive before requesting another memory cycle.

The two command conditions

The status setup margin is referenced to the middle of the first or fourth microprocessor clock cycle and must be valid by the middle of the first clock cycle. The controller's PE setup margin is referenced to the beginning of the first microprocessor clock-pulse cycle and must be valid by the end of the same clock pulse.

The PE input selects the controller for a valid memory access. It can be generated either from the address bus or by using one of the iAPX 186's programmable chip select pins (as in the aforementioned workstation).

The memory controller's RD, WR, PCTL, and PE inputs require a 0-ns hold time to their respective clock edges, and since the system has a 50-ns and 29-ns setup-time margin, it is well beyond the necessary specification. The chip latches the command lines internally if a refresh cycle delays a memory cycle from starting. Thus the memory cycle can begin as soon as the refresh cycle finishes, even if the microprocessor's status signals have gone inactive. The hold-time specification is always met since this internal latch resets only after the information is no longer needed by the controller.

As for address setup-and-hold margins, the addresses must be stable before RAS goes active and must remain stable for two microprocessor clock periods thereafter. The setup timing margin is referenced between the micro-

processor's clock edge, which issues the addresses, and the controller's clock edge, which sends out RAS, minus the respective delays. The address setup timing margin is at least 16 ns and more typically 36 ns.

Internally, the chip latches AH_0 through AH_8 with CAS to supply the column address hold time (t_{CAH}). Latching occurs near the end of the second microprocessor clock cycle for reads and close to the end of the third microprocessor clock cycle for writes. When the RAM cycle is delayed due to refresh, the timing of the Advanced Acknowledge (AACK) signal ensures the two-clock-hold requirement is met.

The controller's AACK is meant to be connected to the SRDY input on the iAPX 186 after being inverted. AACK is issued at the beginning of the second microprocessor clock cycle and must be valid at the start of the third. If the setup margin were inadequate, a lockup (endless wait states) would prevail. The margin for this parameter is 33 ns. AACK lasts for two clocks pulses and is issued from a falling clock edge. It is always sampled by the iAPX 186 one clock cycle into the signal. There is a hold time of about one clock cycle (125 ns).

The iAPX 186's 15-ns hold requirement (TCLSRV) is always met, but it applies only when Ready is being looked at by the iAPX 186. Transitions that occur elsewhere in the bus cycle have no effect.

Write timing

During write cycles, data from the iAPX 186 must be valid at the dynamic RAM when CAS goes low and must satisfy the memory's RAM data-in setup time (t_{DS}) specification. Data must then be held valid and referenced to CAS long enough to meet the dynamic RAM data-in hold time (t_{DH}) specification. When neither condition is met, the dynamic RAM will not read in and store the intended information reliably.

In the foregoing workstation, the Data Enable signal (DEN) is the limiting factor in the data setup margin. (DEN is provided by the iAPX 186 as an Output Enable signal for data transceiver chips.) DEN is active before data is issued by the iAPX 186, but there is a significant delay before the buffer is active. That means write data will be valid at the buffer before it is fully capable of transmitting data. The



High quality. Low price. New **KEMET® AXIMAX™** capacitors give high-volume users the best of both.

Now KEMET ceramic capacitors come in a new, economical package that puts punch in your production. But not in your pocket.

Low-cost AXIMAX capacitors are axial-leaded, conformally-coated units with the same superior construction you've come to expect from all KEMET capacitors, whether solid tantalum, multi-layer ceramic, or precision thin-film. But at a budget-pleasing price.

In four case sizes with COG (NPO) ultra-stable, X7R stable or Z5U general-purpose dielectric, AXIMAX capacitors offer over 138 capacitance values from 10.0 pF to 1.0 μ F, in 50 and 100-volt ratings.

They're assembled with high-temperature solder that maintains lead integrity.

And their wide-range selection and performance let you use them everywhere quality counts—such as bypass and decoupling circuits for telecommunications, data processing,

automotive and entertainment systems.

New KEMET AXIMAX ceramic capacitors are available now in 2,500 and 5,000-unit taped reels, and conform to EIA specification RS 296D—ready for high-speed, automatic insertion. With exclusive EPIC delivery, direct from inventory.

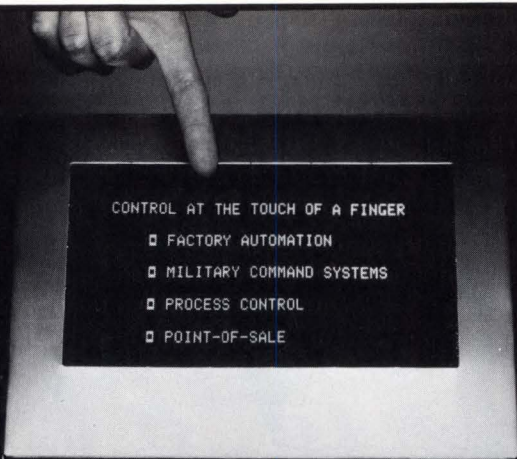
For lead-taped engineering samples, contact:
 Union Carbide, Electronics Division, Components Department,
 P.O. Box 5928, Greenville, SC 29606. (803) 963-6348.
 TWX: 810-287-2536. Telex: 57-0496.
 Union Carbide in Europe: Phone Geneva, 41-22-396511;
 Telex: 845-911302.
 Union Carbide in Asia: Phone Hong Kong, 852-372-31211;
 Telex: 780-45162.
 Or call your local KEMET representative or distributor.



**ELECTRONICS DIVISION
COMPONENTS DEPARTMENT**

KEMET offers you more in the '80s.

See EEM for KEMET capacitors general catalog.
 KEMET is a registered trademark of Union Carbide Corporation.



**User Friendly.
Designer Friendly.
Buyer Friendly.**

VuePoint II™

Flat panel, touch input display system. . . what more could you ask of a friend.

USER FRIENDLY — The proven technology of VuePoint II™'s 12 line by 40 character gas plasma display and 12 x 20 resolution optical sensing, responds instantly to the user's touch. Menu-prompted, touch-interactive operation enhances productivity of unskilled operators.

DESIGNER FRIENDLY — The system software designer will love VuePoint II's touch-interactive possibilities and standard 3 page display memory (expandable to 143 pages). Smart system features like formatting, field definition and cursor control make software design even easier.

Hardware designers will appreciate the low profile package (only 8 5/8" X 12" X 4") for those tight spaces and front display seal for those wet or grimy applications. The standard RS 232 port can be adapted to accommodate RS 422, 423, 485, 20mA, TTL and others. The modularity and structural integrity of VuePoint II provides for ease and speed of design integration. Expandable hardware options adapt VuePoint II™ to your specific system requirements.

BUYER FRIENDLY — Best of all, this second generation technology is available at below first generation cost, which will make you a lot of friends with management and your customers.

SPECIAL EVALUATION UNIT OFFERED AT THE 100 QUANTITY PRICE OF \$1767
(regular quantity 1 price: \$2295).

You've got friends at General Digital®. Call or write us for additional information. We'd like to help.

 **General Digital Corporation**

700 Burnside Avenue,
East Hartford, Connecticut 06108
Telephone: (203) 528-9041

DESIGN ENTRY

Dynamic RAM controller

setup timing margin is referenced to the clock edges that issue DEN and CAS, minus delays. The setup timing margin is 132 ns.

The hold-timing margin is referenced to the clock edge that issues CAS when valid data disappears. DEN is the controlling signal because it can go inactive before the iAPX 186 floats the data bus. Again, without adequate data hold time, the dynamic RAM may or may not recognize the intended data. The hold time margin is 46.5 ns.

The length of the WE pulse may cause problems with back-to-back bus cycles. Shortening the pulse width, however, does not cause any other problems. The easiest solution is to latch A₀ and the Bus High Enable signal (BHE) with the controller's AACK signal. (BHE is provided by the iAPX 186 and is used to determine if data is to be enabled onto the most significant half of the data bus—usually defined as D₁₅-D₈.)

The workstation needs a buffer in the data path because the memory controller will not stop driving data onto the bus until after the end of the fourth microprocessor clock cycle. When back-to-back bus cycles are the rule, that causes bus contention and reduces address-to-ALE setup timing margins.

The dynamic RAM access parameter is called t_{CAC} and is referenced from the active edge of CAS rather than RAS. This parameter varies widely among memories. The different access time margins should be noted, since some trade-offs between buffer speed and t_{CAC} delays must be considered.

Typically, the dynamic RAM controller starts a memory cycle at the end of the iAPX 186's first clock cycle, and data must be valid by the end of the third clock cycle. In the presence of refresh cycle interference (delayed bus cycles), information would still have to be valid within two clock cycles. The timing of the controller's AACK signal guarantees this. Buffer delays, t_{CAC} delays, and other timing delays must be subtracted from the chip's specified two-clock margin. □

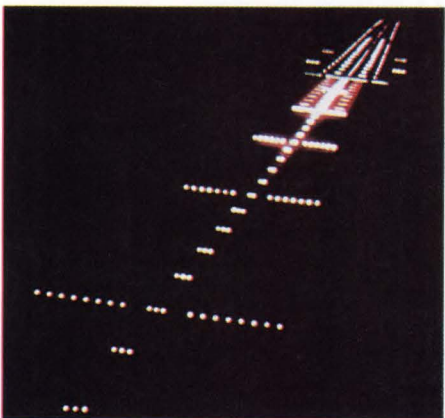
How useful?

Circle

Immediate design application
Within the next year
Not applicable

553
554
555

New 2018/19 Signal Generator options test Radar and Avionics



The Marconi 2018 and 2019 Signal Generators now offer cost effective options for demanding applications. For test and maintenance of radar systems, the pulse option offers better than 65 dB carrier on/off ratio at 70 MHz. And the wideband circuits allow fast pulse edges to be handled.

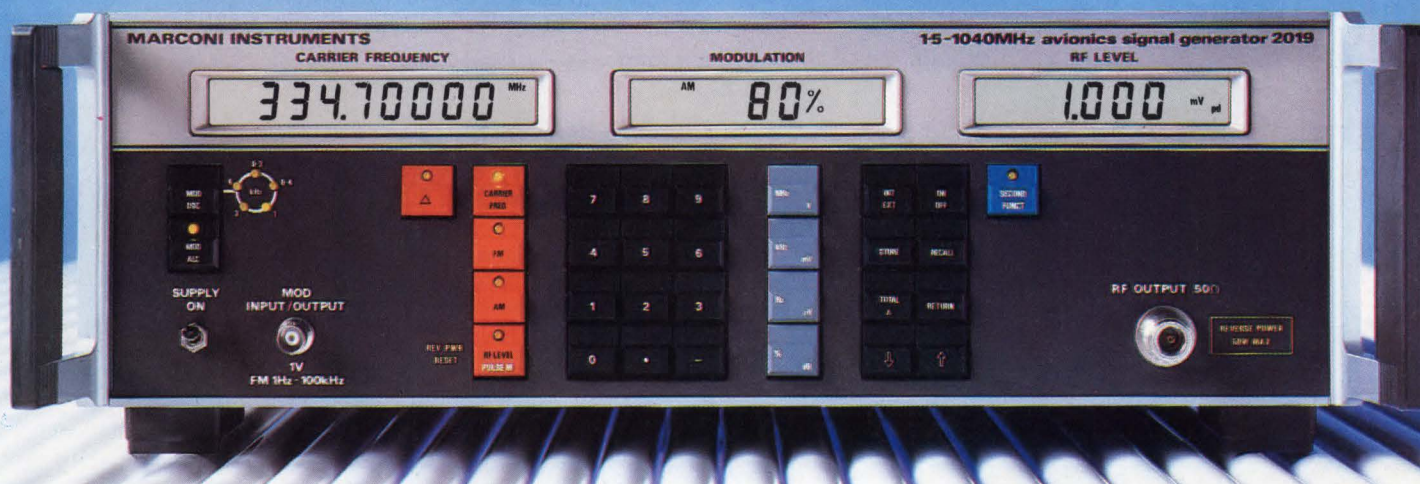
The 0.045% DDM performance of the avionics option meets the ILS test requirements. For simulating VOR transmissions the A.M. circuits are d.c. coupled for minimal phase shift.

Ground support equipment for radar, ILS, VOR and radio communications up to 1040 MHz can now be characterised quickly and cost effectively with only one signal generator.

The Avionics and pulse modulation are just 2 of a series of 4 options now available for the Marconi 2018 and 2019 signal generators. All their successful features of course are retained; the 50 settings available for instant recall, simple keyboard operation, and the ease of maintenance and straight forward calibration. All these features and many more, are available manually, or automatically with the addition of the GPIB interface.

These Marconi Signal Generators can now be configured for your application. They combine outstanding value with superb performance and high accuracy. Look at your options and choose Marconi.

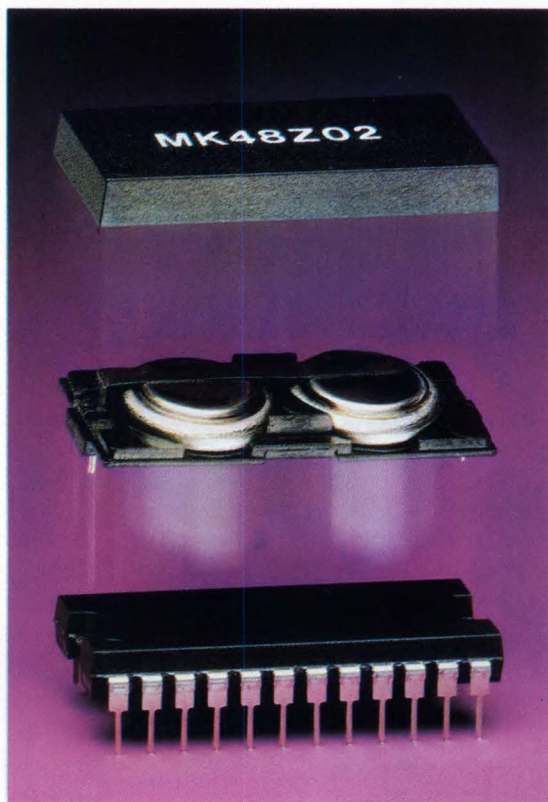
Write or call for details today.



U.S.: 3 Pearl Court, Allendale, N.J. 07401 (201) 934-9050 (East) • (714) 895-7182 (West)
U.K.: Longacres, St. Albans, Herts AL4 0JN Country Code 44 (0272) 59292. TELEX 23350
FRANCE: (1) 687-36 25 • W. GERMANY: (089) 845085 • CANADA: 514-341-7630



UNFORGETTABLE



At last, random access memory that won't let you down. Introducing Mostek's MK48Z02. We call it ZEROPOWER™ RAM. You'll call it unforgettable.

Because that's exactly what this new non-volatile RAM does. It keeps its memory. Thanks to the integration of advanced CMOS technology, ZEROPOWER RAM has an on-board, long-lived lithium energy source. That means ZEROPOWER RAM does not forget, even if the power goes down. ZEROPOWER RAM can keep on remembering for over 10 years without power, drawing less than one nanoamp at room temperature in the power-down mode. Plus it can be reprogrammed quickly and efficiently, as often as you want, without the wear-out mechanisms associated with E²PROMs.

Also, this amazing new RAM can be read to and written from like the static RAM it is. Data access is 150 nanoseconds with an active power consumption of 330 milliwatts. And the MK48Z02 can replace existing 2K x 8 static RAMs, directly conforming to the popular byte-wide 24-pin DIP package. No other components are needed.

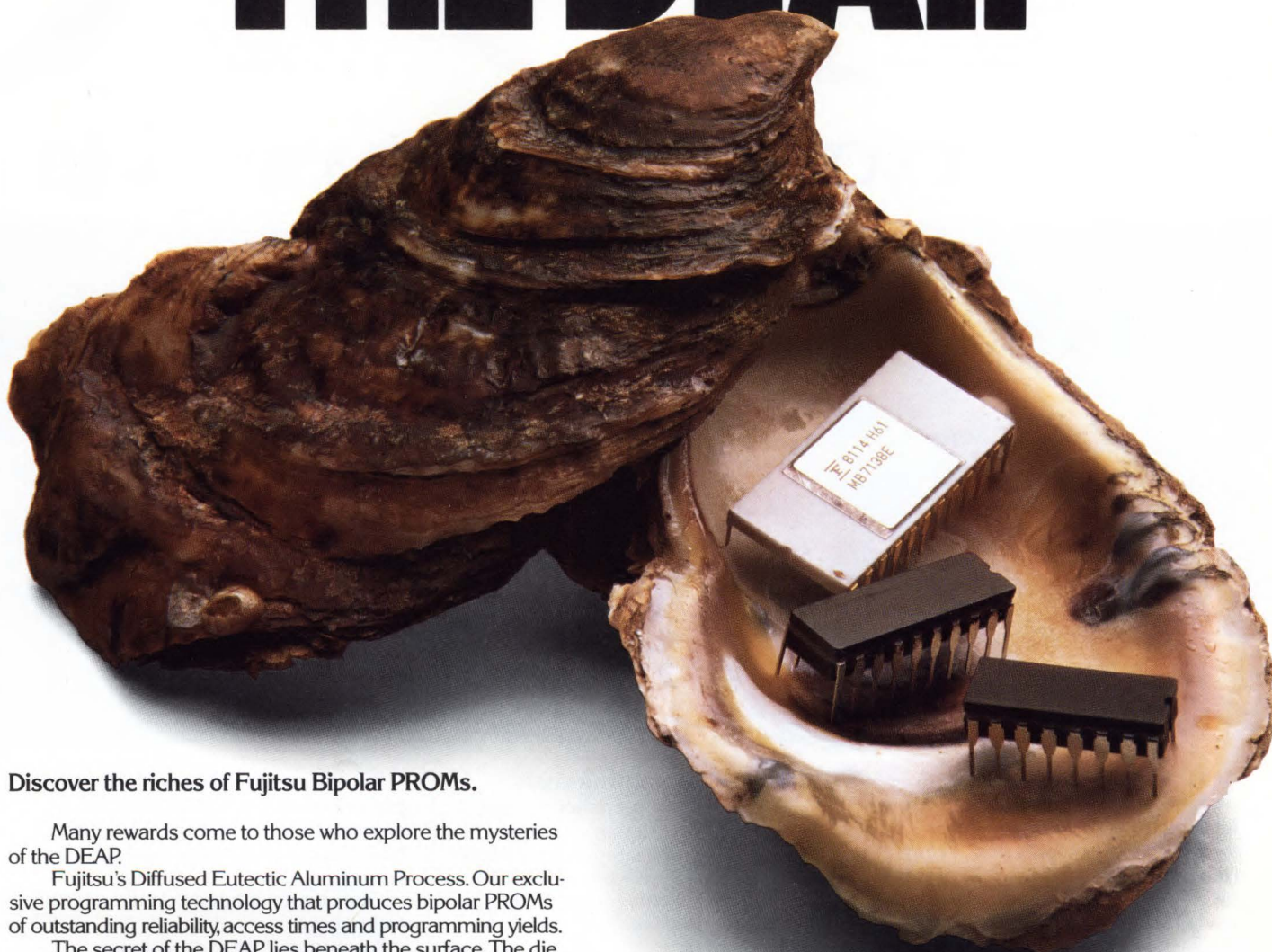
So when you are looking for memory power that lasts, remember Mostek's MK48Z02 ZEROPOWER RAM. It's the unforgettable memory.

For more information, contact Mostek, 1215 W. Crosby Road, MS2205, Carrollton, TX 75006, (214) 466-6000. In Europe, (32) 02/762.18.80. In Japan, 03/496-4221. In the Far East (Hong Kong), 5-681157.

ZEROPOWER is a trademark of Mostek Corporation.



TREASURES OF THE DEAP™



Discover the riches of Fujitsu Bipolar PROMs.

Many rewards come to those who explore the mysteries of the DEAP.

Fujitsu's Diffused Eutectic Aluminum Process. Our exclusive programming technology that produces bipolar PROMs of outstanding reliability, access times and programming yields.

The secret of the DEAP lies beneath the surface. The die surface. There below is where we program a Fujitsu PROM cell.

First, by applying a reverse current to the cell and heating the appropriate junction to form an aluminum-silicon eutectic. Which, in turn, diffuses through the surface and shorts the junction.

It's simple. And much cleaner than blowing fuses on the die surface like ordinary PROMs. Which not only contaminates the passivation layer, but leads to "grow-back." Where blown fuses actually reconnect and scuttle the entire circuit.

That's a danger you'll never encounter with Fujitsu PROMs. They're reliable. With an average 97% programming yield.

And because DEAP lets us produce PROMs of greater density, you enjoy the fastest access times around. For example, our 64K PROM at 55 nanoseconds is the fastest in the industry.

But one of the nicest discoveries about our bipolar PROMs is that they're available in quantity. In densities from 2K to 64K. And in a variety of packages.

So don't wait. Call the nearest FMI sales office listed below. And say you're ready to take the plunge.

FUJITSU
MICROELECTRONICS, INC.
Technology that works.

3320 Scott Boulevard, Santa Clara, CA 95051 • 408/727-1700

FMI Sales Offices. Atlanta 404/449-8539. Austin 512/343-0320. Boston 617/964-7080. Chicago 312/885-1500. Dallas 214/669-1616. Houston 713/784-7111. Minneapolis 612/454-0323. New York 516/361-6565. No. Calif. 408/866-5600. S. Calif. 714/720-9688. ©1984 Fujitsu Microelectronics, Inc. DEAP is a trademark of Fujitsu.

MOTC

Cut your time at the voice/data



As a communication systems designer, you have a difficult time keeping up with voice and data switching technologies. The recent trend toward combining telecommunication and computer products has made the voice/data market increasingly complex.

You can often get stuck right at the drawing board with new product designs.

Call us now, toll free, and we'll show you how state-of-the-art semiconductor technologies and over 150 innovative products can simplify challenging design-in tasks yet meet the complex market requirements of low cost, high performance and extreme versatility in the rapidly changing voice/data world.

Slash system cabling costs.

When the key requirement is cost, Motorola has the high technology answer. Take, for example, our Universal Digital Loop Transceiver (UDLT). This specialized integrated circuit system meets your customer's desire to avoid added data cable costs by allowing simultaneous high-speed data and voice to be transferred over common twisted-pair telephone wiring.

By integrating a PBX with the UDLT, the user can achieve a voice/data phone at every desk with the existing telephone wire in sprawling single-site commercial facilities. The resulting total network provides the optimum in performance for cost.

The UDLT is the first of its kind on the market; far ahead of any competitor.

Over 150 specialized devices for voice/data.

In addition to the added features and cost saving advantages of the UDLT, Motorola provides the broadest line of discrete semiconductors and bipolar and MOS LSI integrated circuits for voice/data applications.

For advanced telephone designs, put all the basic telephone functions on a single IC, including DTMF dialer, tone ringer, speech network and line voltage regulator.

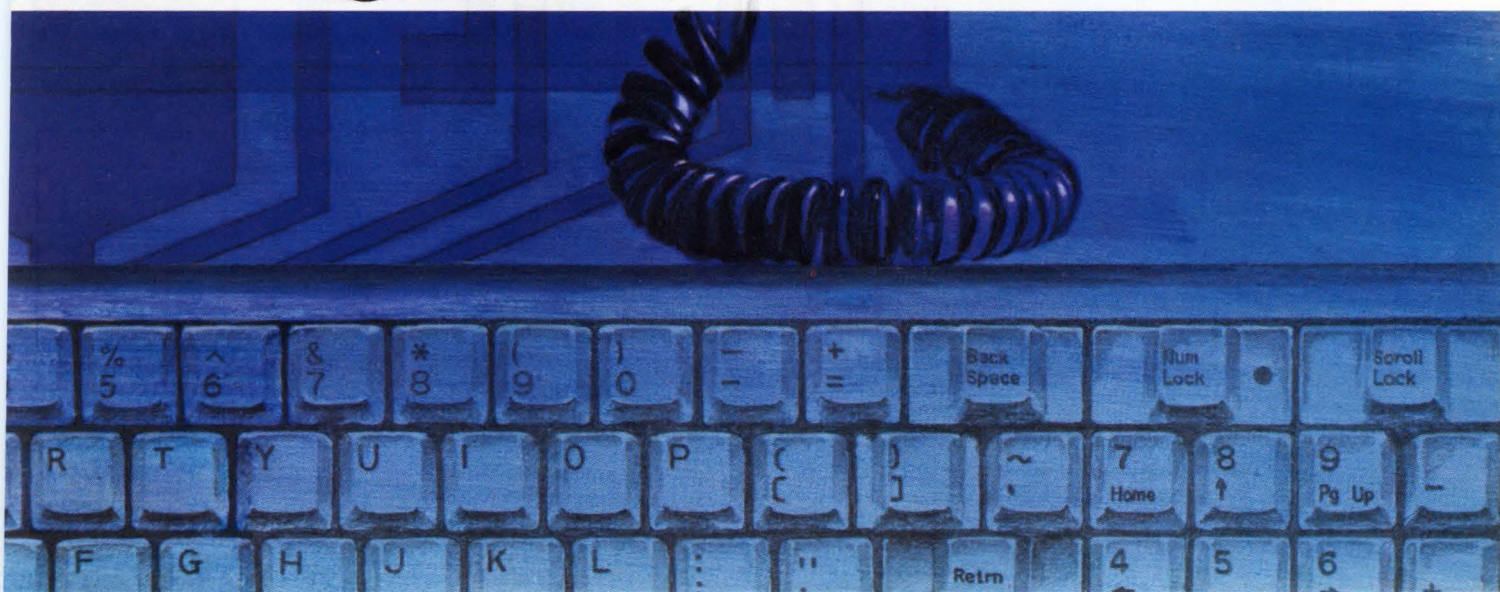
One-chip telephones. At the edge of technology.

To support your conventional modem needs, Motorola has a line of integrated modem ICs to simplify your design and manufacturing requirements. Single-supply operation and standard clock frequencies keep it simple. And inexpensive.

In sensitive data communication applications, Motorola provides fiber optic coupling devices with exceptional isolation, high current transfer ratios and industry standard packaging that outperform and cost considerably less than traditional electrical, coaxial or hard-wired transmission systems. Fiber optics. Light years ahead.

DROLA

drawing board. Call 1-800-521-6274.



At the forefront for a reason.

Competition is intense to put integrated voice/data applications together while still meeting the demands of the user to be cost effective. With these stakes you cannot afford to trust an odd assortment of suppliers with yesterday's products. A total systems company geared to the future can keep your user's capital investment from becoming obsolete.

Motorola has built a complete system of integrated voice/data chips. We've targeted technologies to your market needs and applied design expertise to improve yield and reduce costs. And most importantly, we've maintained a fierce commitment to new products.

It all starts with design support from our massive staff of field application engineers. One's near you. An application engineer who can match new semiconductor technologies and products to your communication applica-

tion requirements so that, with your unique designs, you can perhaps leapfrog your competition. Fast.

1-800-521-6274

Talk engineer to engineer.

Motorola has tripled the number of application engineers it has throughout the U.S. and Canada.

Each has the expertise in emerging semiconductor technologies that can electrify your new voice/data ideas. Call 1-800-521-6274 and discuss your applications. Any time between 9 A.M. East Coast and 5 P.M. West Coast time. Toll free. Talk to our specialists. They'll discuss your applications and get you in touch with a field application engineer who'll, in person, describe in depth how Motorola voice/data products can cut your design time and keep you from going back to where it all starts. The old drawing board.

Wait'll you hear what we have in store for your new design. Be it in voice/data communication, office or

factory automation, entertainment equipment or any electronics-driven product, we'll work with you at any level of chip, board or box integration through the industry's premier technical field organization.

A Motorola semiconductor field application engineer is in the right location with the right expertise to help you.

Call us on it. One call. One source.

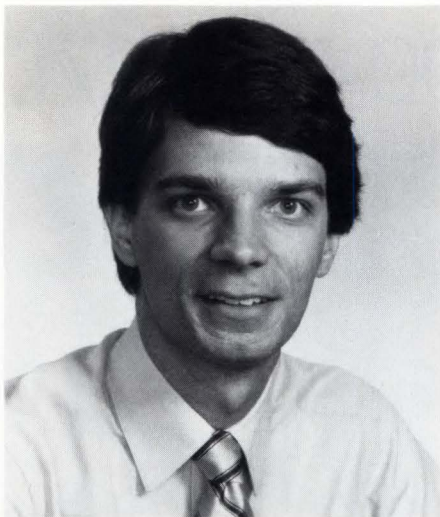
For all your semiconductor needs.
Motorola
Semiconductor
Products Inc.
P.O. Box 20912
Phoenix
AZ 85036

**We're
on your
design-in
team.**



MOTOROLA

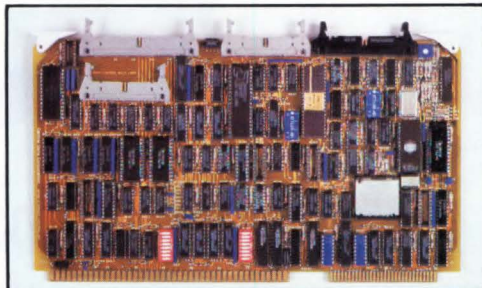
Central Data is Multibus* I/O Control



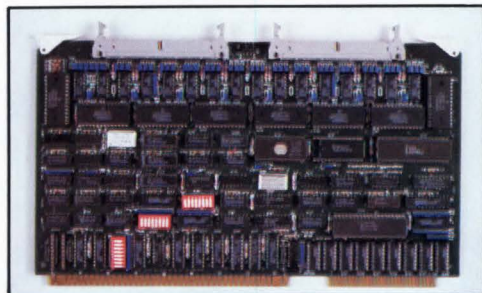
Jeff Roloff, President

"Our commitment to excellence is clearly visible in our Multi-Media Controller and High Performance Terminal Controller. Both offer you the quality and performance you have come to expect from Central Data."

The new **Multibus Multi-Media Controller** is the industry's first to support up to 12 storage media — four each 5¼" Winchester disks, floppies and QIC-02 streaming tape drives, and at an economical price. On-board buffers provide 1:1 interleave transfers and the board supports both bus-vectored and non-bus-vectored interrupts. The board self-tests internally and corrects up to 11-bit burst errors with a 32-bit ECC for Winchester drives. For even greater performance, an optional iLBX* DMA interface is available with the board's (80188) 8/16-bit processor. The **B1030** is available in 100 up pricing at \$895.



The new **High Performance Terminal Controller** can operate at 9600 baud-full duplex to all eight channels without loss of input characters. Each channel can be programmed for baud rates to 19.2Kb. The powerful Intel 8088 processor handles all I/O interrupts, freeing time for the host processor. 64K of dual-port RAM is used as buffers for data in and out, with bus lock and parity error detection supported on both ports. Bus-vectored and non-bus-vectored interrupt modes are supported. And for maximum convenience and reliability, the board comes complete with two 60-pin locking right angle headers. The **B1031** is available in 100 up pricing at \$705.



New 1984-85 Fall Product Catalog now available. Call or write for your copy.



Central Data

Central Data Corporation
1602 Newton Drive
Champaign, IL 61821-1098
217) 359-8010
TWX 910-245-0787
(800) 482-0315 Outside Illinois

* Multibus and iLBX are trademarks of Intel Corporation

CIRCLE 148

Your
Complete
Multibus
Source

GET THIS.

FROM THIS.

MULTIWIRE[®] DESIGN CENTERS PROVIDE SCHEMATIC REDUCTION.

Working with a sophisticated CAD system, your Multiwire Design Center can shorten your design cycle by weeks, saving you thousands of dollars.

We offer a variety of design services, depending upon your needs. Your boards are designed from as little input as a logic diagram or net list, along with board geometry and special parameters.

Multiwire designs and fabricates finished boards to meet both your routine and accelerated delivery requirements. In fact, you can receive a finished board from schematic in as little as four to six weeks,

including design time.

And when you need to make changes, they will be simple and fast. That's because Multiwire boards only use artwork to distribute the power and ground potentials. So a logic change is simply keyed into the computer, creating new floppies for wiring and drilling, and the circuitry is rerouted for your next board.

When it comes to moving a project from paper to prototype to production, nobody does it faster or more economically than Multiwire. To learn more, return the coupon, or circle the reader service number.

MULTIWIRE

10 Andrews Rd., Hicksville, NY 11801

- ☐ Please send me your 8-page sales brochure.
☐ Please have a salesman call.

Name _____

Title _____

Company _____

Address _____

City/State/Zip _____

Telephone _____

ED

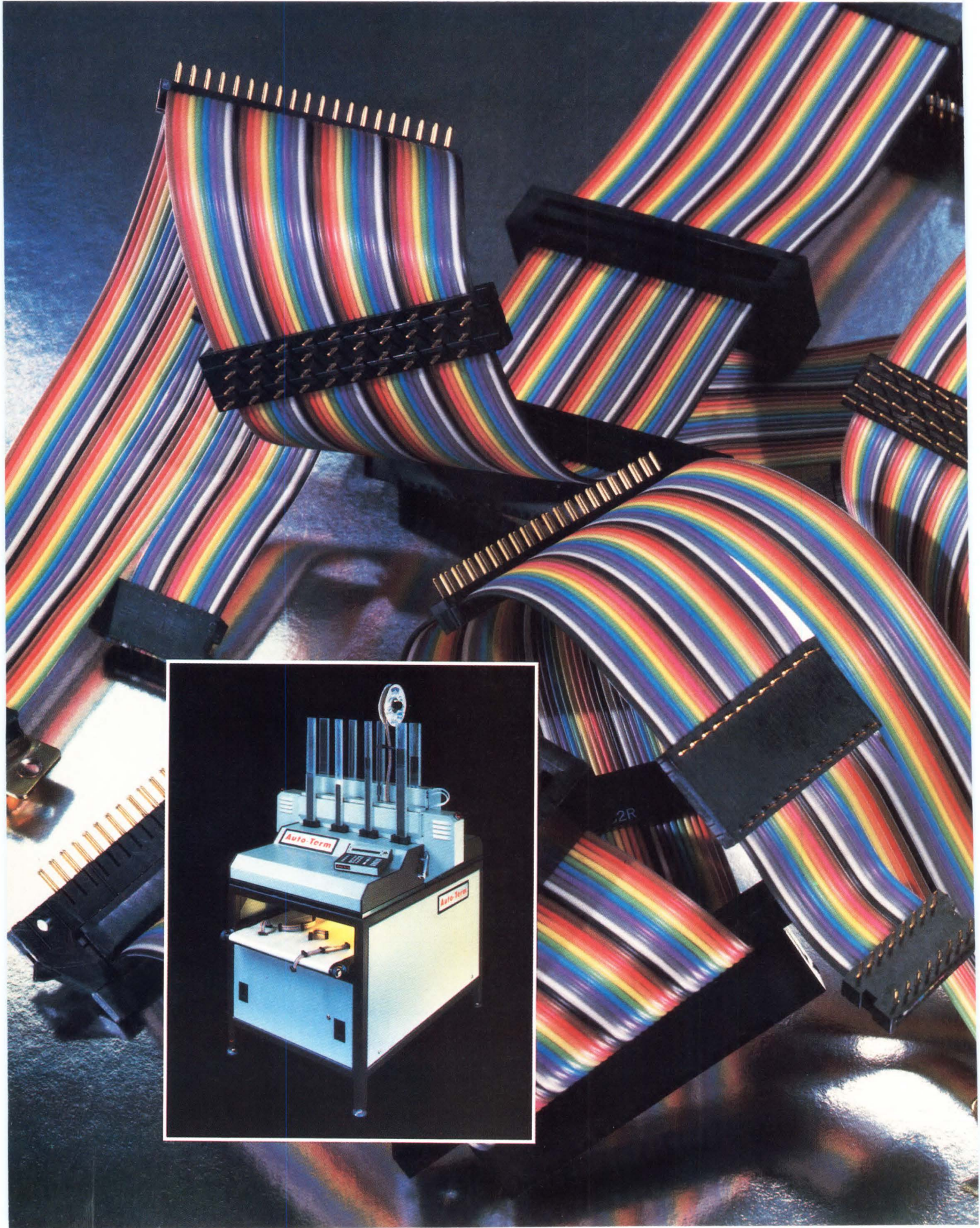
CIRCLE 149



MULTIWIRE/EAST 250 Miller Place, Hicksville, NY 11801 (516) 933-8300; MULTIWIRE/NEW ENGLAND 41 Simon St., Nashua, NH 03060 (603) 889-0083
MULTIWIRE/WEST 3901 East La Palma Ave., Anaheim, California 92807 (714) 632-7770; MULTIWIRE/ADVANCED MANUFACTURING GROUP 10 Andrews Rd., Hicksville, NY 11801 (516) 938-2000
Multiwire is a U.S. registered trademark of the Kollmorgen Corporation.

See Us At Wescon, Booth #'s 1588-90

Get the lowest applied



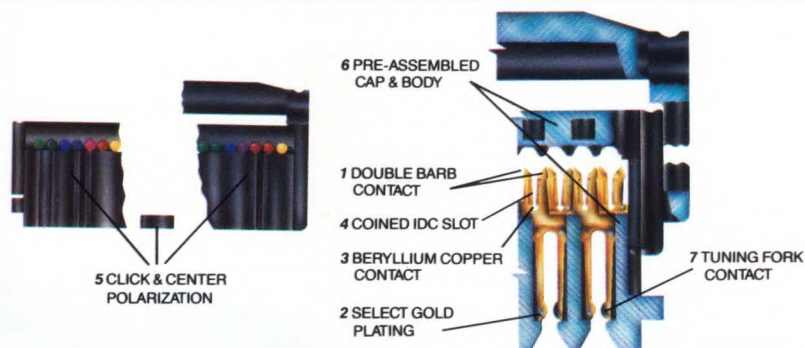
IDC costs in the industry!

Step up to the price, reliability and performance advantages of Multi-Term™ Interconnect Systems from Midland-Ross.

We offer you more than the lowest applied IDC cost in the industry. We offer you the reliability, performance and delivery to match. Take a close look at our Multi-Term concept and you'll see why we should be on your Qualified Vendor List.

7 Our unique tuning fork socket contact gives you proven military grade reliability at less than commercial cost.

When you put us on your Qualified Vendor List, you'll get the combined market commitment and resources of the



1 Unlike the competition, we use unique locking barbs to lock the cover across the entire width of cable, ensuring positive cap to contact retention even under severe strain and vibration.

2 Select plating provides maximum performance at minimum cost.

3 Beryllium copper contacts ensure excellent contact memory and prevent creeping in the insulation displacement slot.

4 A coined insulation displacement slot prevents wire nicking.

5 Both click and center slot polarization prevent reverse mating and make all Multi-Term connectors 100% industry-compatible.

6 The pre-assembled cap and body make termination faster and more cost-effective.

Electronic Connector Division of Midland-Ross Corporation. Our connector line is second to none. We're constantly working to maximize our application capabilities with products like our Auto-Term™ IDC cable assembly machine, for the lowest applied IDC assembly cost in the industry. And we're ready to go that extra step to give you the level of field and distributor service you've been asking for. It's worth your time to take a closer look at our Multi-Term Interconnect System.

Midland-Ross Corporation
Electronic Connector Division
Cambion • Hollingsworth • SAE
One Alewife Place
Cambridge MA 02140
(617) 491-5400.

CIRCLE 150

MIDLAND ROSS

See us at the Wescon Show, Booth #3229.

now...

**WHAT THIS COUNTRY
NEEDS IS A GOOD**

5¢ *ultra
fast switching*
RECTIFIER*



ultra fast switching

HERE IT IS...GENERAL INSTRUMENT'S *^* UF4002

The UF4002 ultra fast switching rectifier has reverse recovery time less than 50 nanoseconds! Plus other excellent features:

- Low forward voltage — less than 1.0 volt at 1.0 ampere
- 30 ampere surge capability
- Forward recovery time less than 25 nanoseconds
- Available in UF4001 thru UF4004, PIV50-400 volts with I_R less than 10 μ amps

- For higher current operation use our 3 ampere UF5400 thru UF5404 series.

***Conditions of Sale:**

Minimum order quantity
50,000 units scheduled within
60 days. Minimum shipment
25,000 pcs.

Packaging: 1,000 units per
box, or 5,000 units per reel.

Marking: Cathode Band,
UF4002, GI.

For complete technical data, information on immediate product delivery, or the latest General Instrument catalog, contact your authorized distributor or:

General Instrument Corporation,
Discrete Semiconductor Div.
600 West John Street,
Hicksville, NY 11801, USA
(516) 933-3333

**GENERAL
INSTRUMENT**

Welcome the newest member of the Panasonic non-impact printer family.

Meet the EUY-3T, the new Panasonic Non-Impact Printer that's minimal in size but not in capability. It prints 40 alphanumeric characters on 80mm paper. Offers thermal printer performance with dot addressable graphics capability. And low power requirements (just 5V/2.5A) make it very economical to operate.

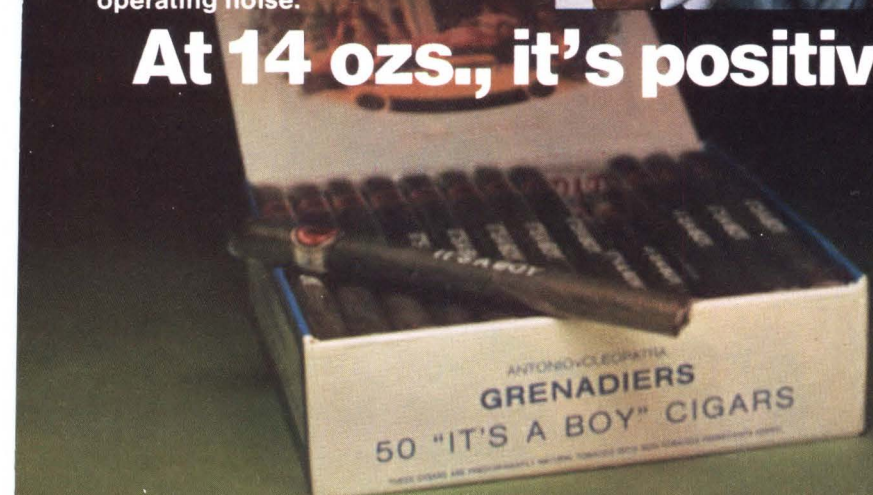
It's the latest addition to a line of electrosensitive and thermal printers famous for being big in reliability, but small where it counts: in size, in cost and in operating noise.



All Panasonic Non-Impact Printers have low all-DC power requirements. And our microprocessor interface modules accept 8-bit Parallel or byte Serial data input (model 3T is also Centronics-compatible). So they're perfect for ATE, printing calculators or other designs requiring low-cost hard copy.

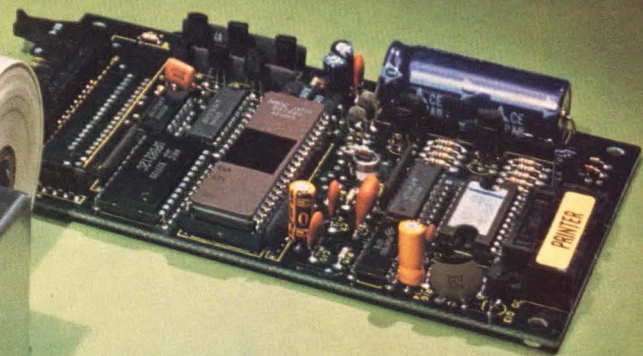
Think our new baby is cute? Ask for complete data and prices - contact Panasonic Industrial Company, Electronic Components Division, One Panasonic Way, Secaucus, N.J. 07094; (201) 348-8080.

At 14 ozs., it's positively precocious.



Series	Column Capacity	Paper Width	Outside Dimensions
EUY-2	15	36mm	71.9 x 33.5 x 55.9 mm
EUY-3T*	40	80mm	121 x 48.5 x 67 mm
EUY-10	15, 21, 32, 40	60mm	90.4 x 42.4 x 110 mm
EUY-5	32, 40, 64, 80	127mm	195 x 65 x 70.1 mm

*Thermal only

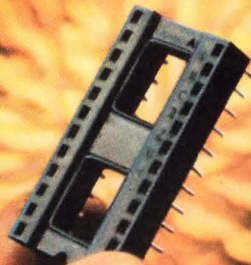


"SEE US AT WESCON BOOTHS 3744-50 & 1040-42"

Panasonic Industrial Company

**You're looking at the first real
breakthrough in Dip Socket
design since we invented GTH*:**

**Burndy
DILPAK™.**



IN EUROPE: Burndy SA, POB 66, Chene-Bourgeries CH-1224, Geneva, Switzerland. Tel. (41) 22-49 48 48

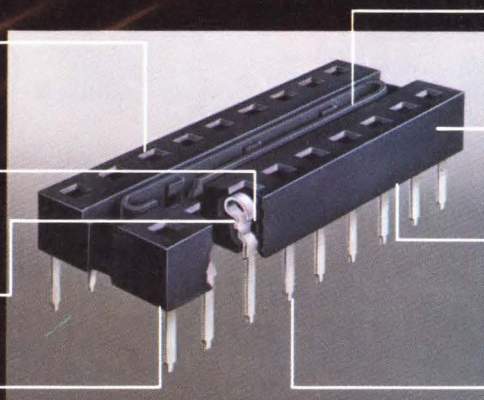
Everything you'll ever want in a Dip Socket...and more!

Chamfered Entry protects contacts; simplifies I.C. insertion.

Patented GTH* contact design delivers good-as-gold performance at a fraction of the cost.

Positive anti-overstress feature.

Closed bottom prevents solder wicking and bridging.



Open Frame Construction facilitates air flow.

Compatible with high speed automatic insertion machines.

Built-in weep holes for positive cleaning and flushing.

Optional solder tail hold-down feature.

Compare our new hi-tech DILPAK socket with any other on the market today — anywhere. Compare performance. Reliability. Convenience. Compare hi-tech features. Compare anything you like — including installed costs!

Our new DILPAK socket wins on all counts! And by a wide margin. We designed it that way. *Right* from the start.

While others were modifying old designs and offering partial solutions — we started from scratch to provide a total answer.

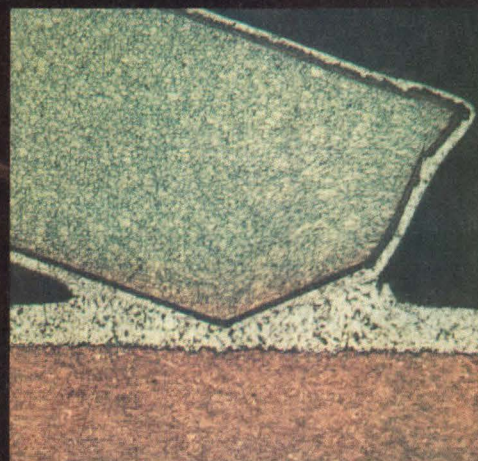
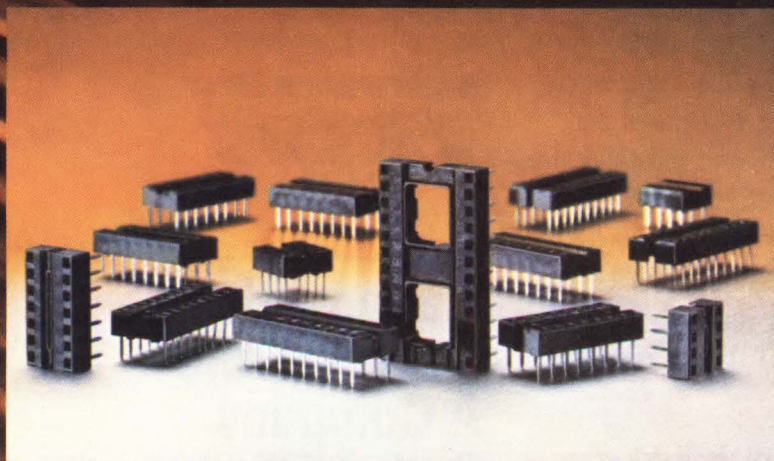
Result? DILPAK — the one DIP socket specifically designed to "fine line" packaging requirements. The one DIP socket that delivers

closed bottom design *and* protective chamfered entry. Solder tail hold-down *and* compatibility with high speed automatic insertion machines. Anti-overstress provisions *and* our exclusive GTH gas-tight, high pressure contact design.

In short — the one hi-tech DIP socket that delivers it all! The total answer to today's hi-tech requirements. And tomorrow's. For complete details, call or write: I. C. Socket Product Manager, Burndy Corporation, Electronics Division, Norwalk, CT 06856. (203) 852-6293.

 **BURNDY**
Offices in principal cities throughout the United States

CIRCLE 187



Available in Full Range of Sizes including 8, 14, 16, 18, 20, 22, 24, 28 and 40 positions.

***Patented GTH Contact Design** assures "good-as-gold" performance without gold.

IN THE FAR EAST: Burndy Japan Ltd., Shuwa Shinagawa Bldg., 26-33, 3-chome, Takanawa, Minato-ku, Tokyo, Japan. 813-443-7211

INTERNATIONAL SALES AND MANUFACTURING: BRUSSELS, BARCELONA, PARIS, ROTTERDAM, STOCKHOLM, STUTTGART, TURIN, ZURICH, ST. ALBANS (ENG.), TORONTO, SYDNEY, TOKYO, MEXICO CITY, SAO PAULO

BURNDY CONNECTS

The one number to call for Winchester and diskette drive repair.



TRW is the disk drive repair service you can count on! Now you can trust your critical repair requirements to the one company with a successful nationwide reputation in electronics maintenance and repair: TRW Customer Service.

We provide Prompt, Professional and Price Competitive Repair Services to meet your Winchester and diskette drive repair needs. Our new Electronics Industry Services capabilities include state-of-the-art Centralized Repair Centers, complete with an east coast Class 100 HEPA environment and

a service history that is truly unsurpassed!

Our repair centers are staffed with teams of factory-trained technicians. These experts have been trained by the same people who built your disk drives and have an established reputation for meeting and exceeding exacting OEM material and calibration specifications. This training and experience provides you with a full "No Questions" 90 Day Warranty on our repairs.

For professional, fast disk drive repairs call TRW. The source for disk drive repair. 1-800-922-0897.

TRW Customer Service

15 Law Drive
Fairfield, NJ 07006

Nationwide Service From A Company Called TRW



No other wideband instrumentation recorder measures up to Storehorse.

Storehorse not only assures the best possible record and replay performance under all circumstances.

It also achieves unrivalled standards in its ease of operation and is the recorder for full compatibility with all other IRIG standard machines.

Time-saving, simple-to-operate, compact...

Advanced features actually make its operation extremely simple—even the inexperienced can 'drive' Storehorse right up to its optimum performance.

Unique automatic calibration and equalisation (ACE) systems permit the setting up of 42 channels in 3 minutes, saving hours of preliminary work! And

memory-stored calibrations save time in adjusting to different tape types and recorders.

A further valuable aid to quick, accurate use is the inbuilt VDU with pages of information—including input/output levels, machine and tape position status, channel sequencing, and replay shuttling.

And in addition you'll enjoy high-precision laboratory performance in a compact transportable machine—almost $\frac{1}{2}$ the size of comparable recorders—which will also measure up beautifully to many field and mobile recording applications. Get the complete Storehorse story now.



Please send colour brochure with further details of Storehorse.

Name

Position

Company

Address

Tel:

Racal Recorders Limited, Hardley Industrial Estate, Hythe, Southampton, Hampshire SO4 6ZH, England.
Racal Recorders Inc., 4 Goodyear Street, Irvine, California 92714, USA.

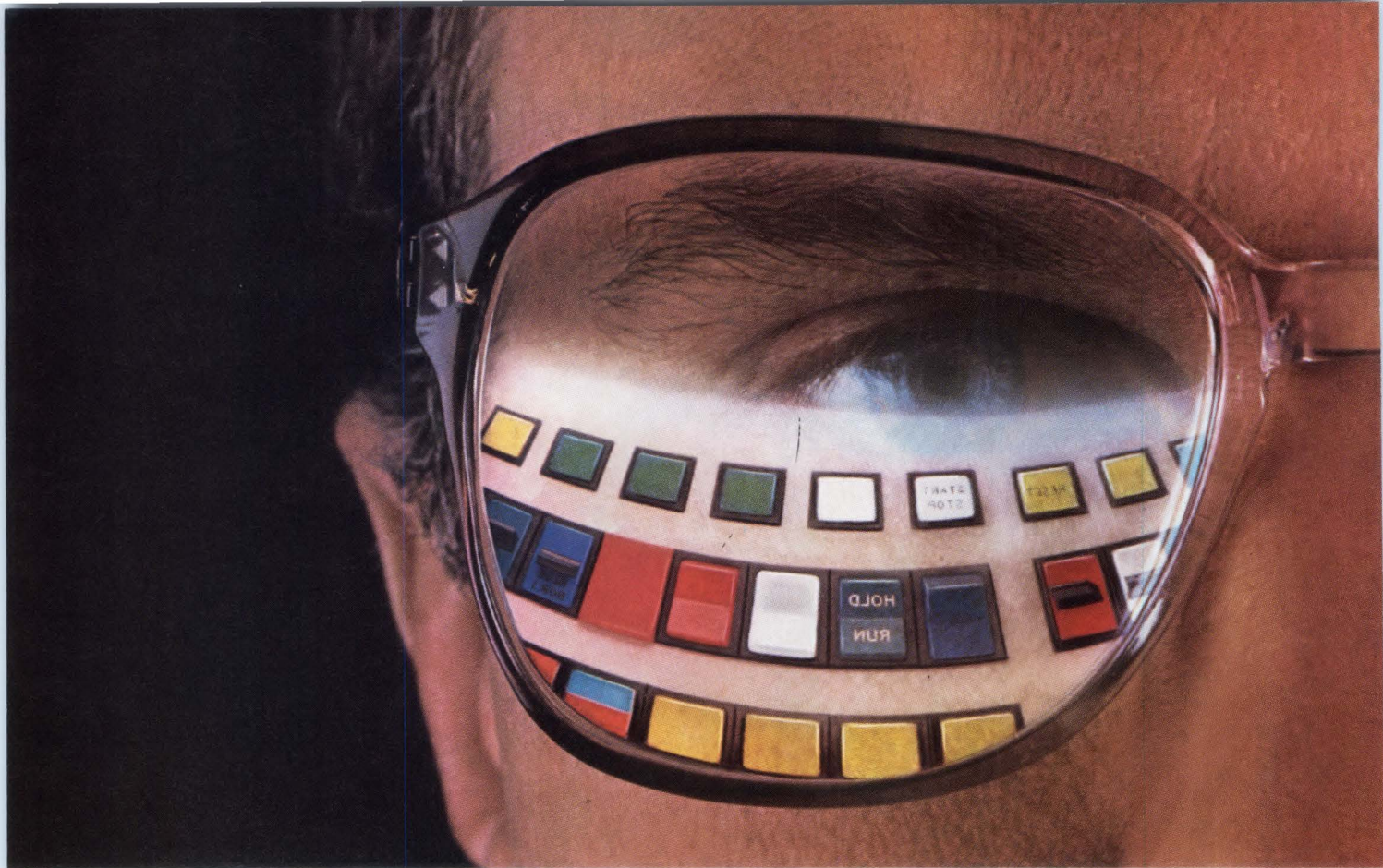
ED 31/10

Racal Recorders always on the right track

Racal Recorders Limited, Hardley Industrial Estate, Hythe, Southampton, Hampshire SO4 6ZH, England. Tel: Hythe (0703) 843265. Telex: 47600.
Racal Recorders Inc., 4 Goodyear Street, Irvine, California 92714, USA. Tel: 714 380 0900. Outside California Toll Free: 800 847 1226 Twx: 6711055.

CIRCLE 189

RACAL



We design our through your

With the first glance, your customer begins to form an impression of your product. And the manual controls you use play a major role in this important first impression—as well as long-run operator satisfaction.

That's why we take great care to build human factors into the design of our manual products. By designing our manual controls from your customer's point of view, we can help make your product look better, feel better, work better and, finally, sell better.

Not only do you get well designed manual controls from MICRO SWITCH, you get lots of them. Our continuing development program has led to a variety of new products to fit specialized requirements. And with the broadest selection of product options in the industry to choose from, you get the flexibility and freedom to design your products to meet your customer's needs.

New looks for new needs.

Our Programmable Display Pushbutton is an excellent example of our ability to respond to emerging needs in the marketplace with new products having unique human factors features. It is a user-friendly pushbutton that provides two-way communication between the system and the operator. Our Programmable Display Pushbutton offers the state-of-the-art ability to display an infinite number of legends when programmed through a computer. This multi-function capability means that one switch can replace dozens, reduc-



ing panel space and viewing area to simplify the operator's tasks and reduce the possibility of error.

Even the best can get better.

We're always working to improve our manual products to meet your changing needs.

For example, based on years of experience in building quality keyboards, we were able to combine quiet operation and excellent tactile feedback in our new Silent-Tactile keyboards. These low profile keyboards look good and feel good. They retain their consistent positive feedback month after month, year after year. Their silent operation helps make work environments more pleasant. Because in a room full of CRTs, it's what you don't hear that counts.



Take your pick from a variety of quality controls.

Constant efforts over the years have resulted in a broad line of human factors-designed manual products. Our touch panels, for example, combine high quality graphics with reliable switch operation. We take special care with such details as embossing for positive finger positioning, snap discs for tactile feedback and high quality color and graphics.



manual controls customer's eyes.

The result:
our products help
make your product
easy to use and good looking, as well as reliable.

The Advanced Manual Line and Miniature Manual Line display the same painstaking concern for detail and quality. They're designed to be visually pleasing—with clean lines, vivid colors, bright, even illumination, attractive shapes and sizes. And their appearance is coordinated, both within and among product groups. So you can build harmony into your design.

Having this wide selection of controls to choose from means you can specify the best combination of performance and price—always with superior human factors features.

Experience you can count on.

For over 40 years we've been building manual products to help solve all kinds of control problems. For years we've been conducting and publishing the results of original human factors research. No other controls manufacturer does. And we work with

Honeywell's industrial design experts to develop new products and materials.

Along the way, we developed special capabilities in plastics, inks, illumination and switching techniques that we can apply to all our manual products.

easy to use and good looking, as well as reliable.

Human factors design ideas—yours for the asking.

We have compiled a wealth of basic human factors design considerations in a 36-page booklet—our Panel Design Guide. You'll find it an invaluable reference tool in planning and designing the interface between man and machine. Simply call or write to get your copy.

The response and support you need.

Whether you need a standard product or a custom solution, you can count on MICRO SWITCH for the help you need. Our experienced field and application engineers are ready to work with you to find the best solution for your project.

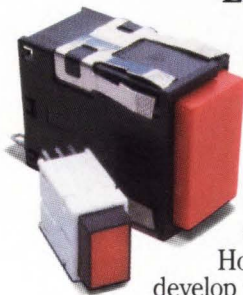
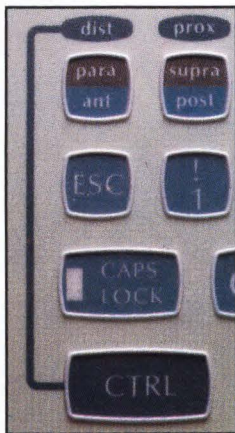
No matter where you are, MICRO SWITCH is ready. For local availability of standard products, just call on one of our Authorized Distributors. And there's our broad network of sales and service representatives around the world.

For the location of a sales office or authorized distributor near you, call 815-235-6600. Or, write MICRO SWITCH, Freeport, IL 61032.

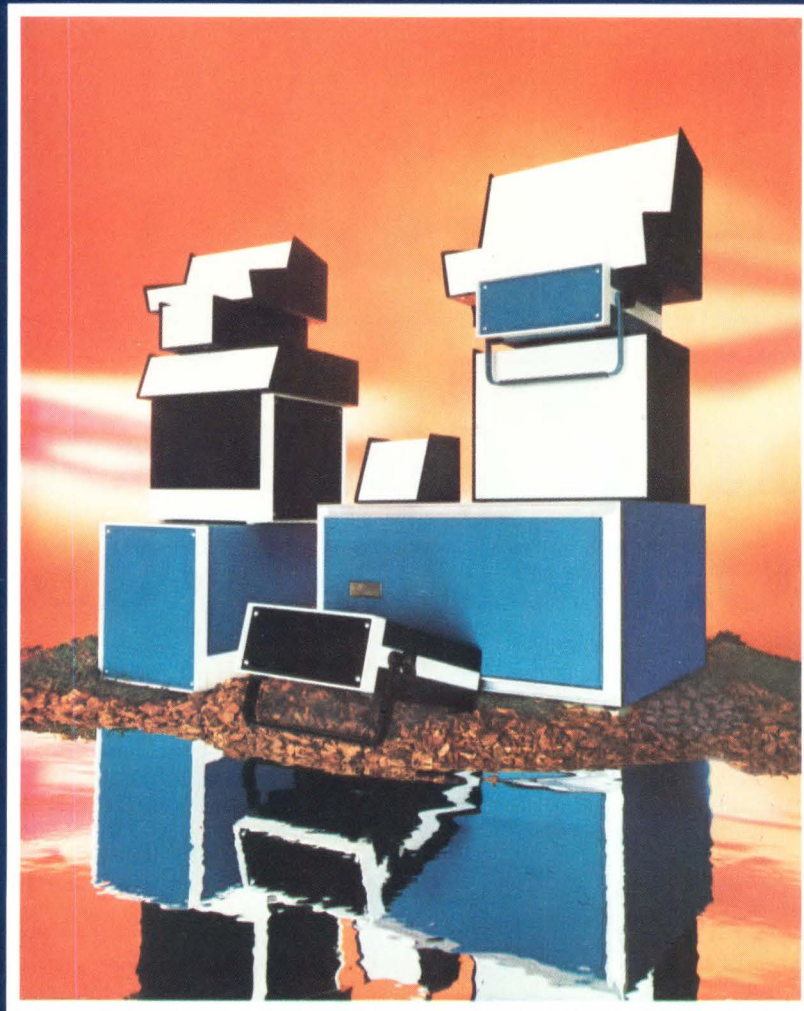
We'll help you find the manual controls and human factors features that work best for you and your product—no matter which way you look at it.

Together, we can find the answers.

MICRO SWITCH
a Honeywell Division



Our Quality is a reflection on you.



Over 300 styles, sizes and colors to meet
your needs...immediately available from stock.
Or let us design a special case for you.

BUD INDUSTRIES, INC.
4605 East 355th Street
Willoughby, Ohio 44094
(216) 946-3200
TWX: 810-427-2604



BUD WEST, Inc.
7733 West Olive Avenue
P.O. Box 1029
Peoria, AZ 85345-0350
(602) 979-0300
TWX: 910-951-4217

CIRCLE 191

When it comes to enclosures, we've got you covered.

We only charge once...

- Rechargeable, nickel cadmium sealed cells for compact, lightweight and lasting power.
 - Cell or battery pack formations.
- At home in portable communication equipment, computer back-up, medical equipment, emergency lighting and airborne systems.
 - Above average temperatures, no problem.
- For a power source that you can use, but hardly use up.



TADIRAN
Electronic Industries, Inc.

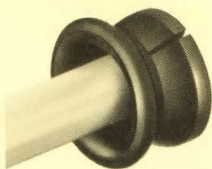
350 5th Ave. New York N.Y. 10118, U.S.A. Telephone: 212-947-4600
Lakeland Plaza Professional Bldg., Suite 263 Lewisville TX 75067, U.S.A.
Telephone: 214-221-7523

6312 Variel Ave. Suite 203, Woodland Hills, CA 91367, U.S.A.
Telephone: 213-884-3884. TLX W.U. 705384.

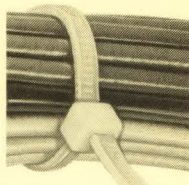
TADIRAN

CIRCLE 192

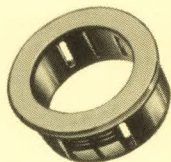
11, Ben-Gurion Street, Givat-Shmuel, P.O.B. 648, Tel-Aviv 61006, Israel, Telex: 341692, Telephone: 03-713111



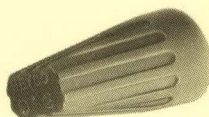
Strain Reliefs



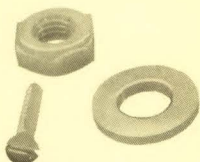
Cable Ties



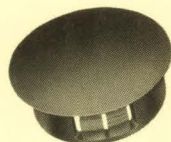
Cable Insulators



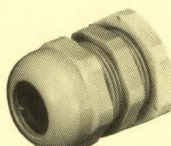
Wire Connectors



Screws, Nuts,
Washers



Hole Plugs



Liquid Tight
Fittings

Put a better clamp on those cables!



Heyco® Nylon Cable Clamps for any size cable or bundle you need to fasten from 1/8" to 1 1/2" diameter. Choose from 26 different sizes, all made of tough, resilient, lightweight nylon that serves heavy-duty needs. All parts are size marked, resistant to aging and most chemicals, and open for easy entry — with all inside edges fully rounded. These clamps meet many military specs.

UL recognized



HEYCO MOLDED PRODUCTS

Call 800-526-4182

(outside New Jersey) for samples,
catalog and further information.

Box 160, Kenilworth, New Jersey 07033

(201) 245-0033 • TELEX 844771

HEYCO DESIGNS SOLUTIONS



DESIGN SOLUTIONS

Simple program finds parts values for phase-locked loop

Steve Lubs

Electronics Engineer
312 18th Ave.
Brooklyn Park, Md. 21225

Phase-locked loops are among the most common and valuable system elements, and desktop computers are now making short shrift of the sometimes difficult and tedious task of designing and analyzing them. An interactive program for the HP 9825 computer (see the program listing) helps the designer determine the best component values for a given PLL filter and then guides him to the closest standard component values.

In a typical second-order PLL (Fig. 1), the phase detector and the voltage-controlled oscil-

lator are selected to satisfy individual design criteria. However, the resistor and capacitor values must be determined by an algorithm based on equations described by Floyd Gardner in his book *Phaselock Techniques*.^{*} The algorithm, represented by a Werner-Orr chart (Fig. 2), is suitable only when phase-detector and VCO transfer gains can be measured independently of loop gain.

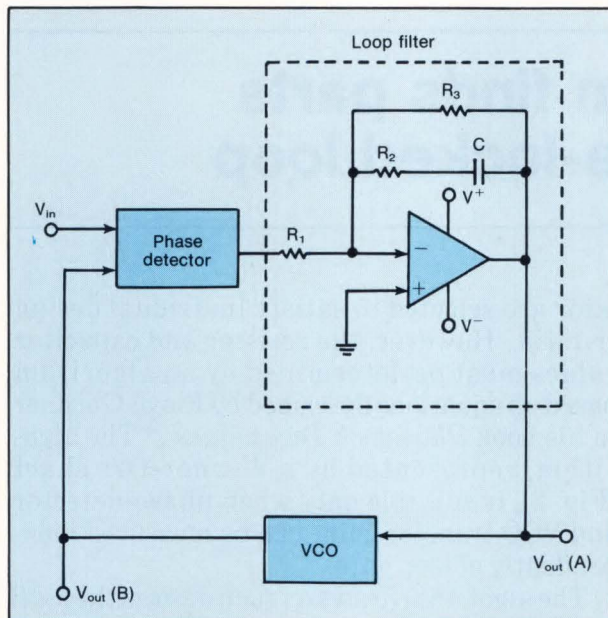
The algorithm draws on such data as the 3-dB bandwidth of the loop in hertz (Fb), the damping factor of the loop (d), the phase-detector transfer gain in V/rad (Kd), and the VCO transfer gain in (rad/s)/V. The value of resistor R₁ is an independent variable within the program.

^{*}Floyd Gardner, *Phaselock Techniques*, 2nd ed. (New York: John Wiley & Sons, 1979).

Designing an active PLL filter

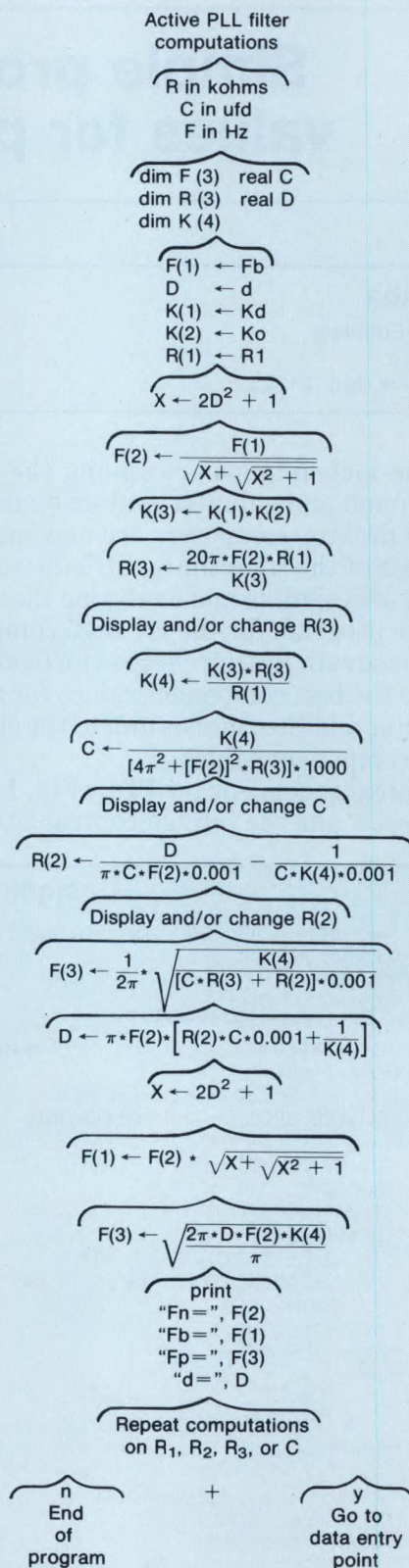
```
0: dsp "ACTIVE PLL FILTER COMPUTATIONS"
1: prt "ACTIVE PLL"
2: prt "FILTER"
3: prt "COMPUTATIONS"
4: prt "*****"
5: prt "R in kohms", "C in ufd", "Frequency in Hz";spc;wait 4000
6: dim F(5); dim R(5); dim K(5); dim A$(5)
7: dsp "PLEASE SPECIFY THE FOLLOWING. . ."; wait 3000
8: ent "3db BANDWIDTH Fb(Hz)?", F (1)
9: prt "**3dB BW", " Fb=", F(1)
10: ent "**DAMPING", D
11: prt "**DAMPING", D
12: ent "PHASE DETECTOR GAIN", K(1)
13: prt "**PHASE DETECTOR GAIN", " Kd=", K(1)
14: ent "VCO GAIN", K(2)
15: prt "**VCO GAIN", K(2)
16: ent "INPUT R1(kohms)", R(1)
17: prt "**INPUT R", " R1=", R(1)
18: 2*D↑2 + 1→X
19: F(1)/√(X + √(X↑2 + 1))→F(2)
20: K(1)*K(2)→K(3)
21: 20*π*F(2)*R(1)/K(3)→R(3)
22: dsp "R3(approx.)=", R(3);wait 5000
23: prt "R3(approx.)=", R(3)
24: ent "ADJUST R3?", R(3)
25: prt "**ADJUSTED R3", " R3=",R(3);spc

26: K(3)*R(3)/R(1)→K(4)
27: K(4)/(4*π↑2*F(2)↑2*R(3))*1000→C
28: fxd 4
29: dsp "(approx.)=",C;wait 500
30: prt "C(approx.)=",C
31: ent "ADJUST C?",C
32: prt "**ADJUSTED C", " C=", C;spc
33: fxd 2
34: D/(C*π*F(2)*0.001)-1/(C*K(4)*0.001)→R(2)
35: dsp "R2(approx.)=",R(2); wait 5000
36: prt "R2(approx.)=",R(2)
37: ent "ADJUST R2?", R(2)
38: prt "ADJUSTED R2", " R2=",R(2);spc
39: prt "NEW PARAMETERS";spc
40: 1/(2*π)*√(K(4)/(C*(R(3) + R(2))*0.001))→F(3)
41: π*F(2)*(R(2)*C*0.001 + 1/K(4))→D
42: 2*D↑2 + 1→X
43: F(2)*√(X + √(X↑2 + 1))→F(1)
44: √(D*2*π*F(2)*K(4))/π→F(3)
45: π*F(2)*(D + 1/(4*D))→N
46: prt "Fn=",F(2), "Fb=",F(1), "Fp=", F(3), "NB=", N, "d=", D
47: ent "REPEAT COMP. ON R1, R2, R3, C (y or n)?", A$
48: if A$="y";spc;prt "NEW CALCULATIONS OF R1, R2, R3, C";spc;goto 16
49: spc 3;end
```

1. Passive components can tailor the operation of a phase-locked loop to a specific purpose. The user must select the phase detector and VCO based on design needs; the program finds the resistor and capacitor values that best meet the design objectives. Depending on the function of the circuit, the output can be taken from either $V_{out}(A)$ or $V_{out}(B)$.

2. The algorithm that determines PLL resistor and capacitor values is visualized through a Werner-Orr diagram. The standard equations need such data as the loop's desired 3-dB bandwidth and the phase-detector and VCO transfer gains.



THE performer.

The Triplet Model 3565...

*Low Cost
Troubleshooting DMM*



only
\$65

1. Hand-held—5 functions, 26 ranges with 200 μ A and 10A AC and DC ranges. Includes carrying case.
2. Overload Protection—all ranges with no nuisance fuse outages for volts and ohms.
3. Single range switch provides operational ease. Safety designed test leads and easy external battery/fuse access.

The Model 3565 includes five functions with 26 ranges and basic DC accuracy of 0.8% Rdg. Includes 200 μ A and 10A AC and DC ranges.

For demonstration, contact your Triplet distributor, Mod Center or representative.

Triplet Corporation, Bluffton, Ohio 45817.
(419) 358-5015, TWX (810) 490-2400.



"See us at WESCON/84 Booth 1330"

When you want QUALITY—
Ask for TRIPLETT

CIRCLE 194
CIRCLE 195 FOR FREE DEMONSTRATION

TT TRIPLETT
A Denril COMPANY

THE performer.

The Triplet Model 3550-A

*Ideal for Field or
Production Troubleshooting*



NEW

only
\$85

1. Handheld—6 functions, 34 ranges with 200 μ A AC and DC, Hi-Lo Ohms/Diode check on all ranges.
2. Overload Protected—All ranges protected with special 2 A/600V fuse arrangement. No nuisance fuse outages on volt and ohm ranges.
3. Audible continuity: Safety designed input jacks and test leads; tilt stand for bench use; easy access to battery and fuse compartment; 2000 hr. battery life, and 10A range.

The new Model 3550-A is loaded with features. Like the human engineered in-line push button range and function switches and overload protection for all ranges. DC accuracy is 0.25% Rdg. Hi and Low ohms on all resistance ranges with audible continuity. 10A AC/DC ranges.

For a demonstration, contact your Triplet distributor, Mod Center or representative.

Triplet Corporation, One Triplet Dr., Bluffton, OH 45817. (419) 358-5015, TWX (810) 490-2400.



When you want QUALITY—
Ask for TRIPLETT

CIRCLE 196
CIRCLE 197 FOR FREE DEMONSTRATION

TT TRIPLETT
A Denril COMPANY

Phone chip makes special-effects sounds

Dennis Morgan

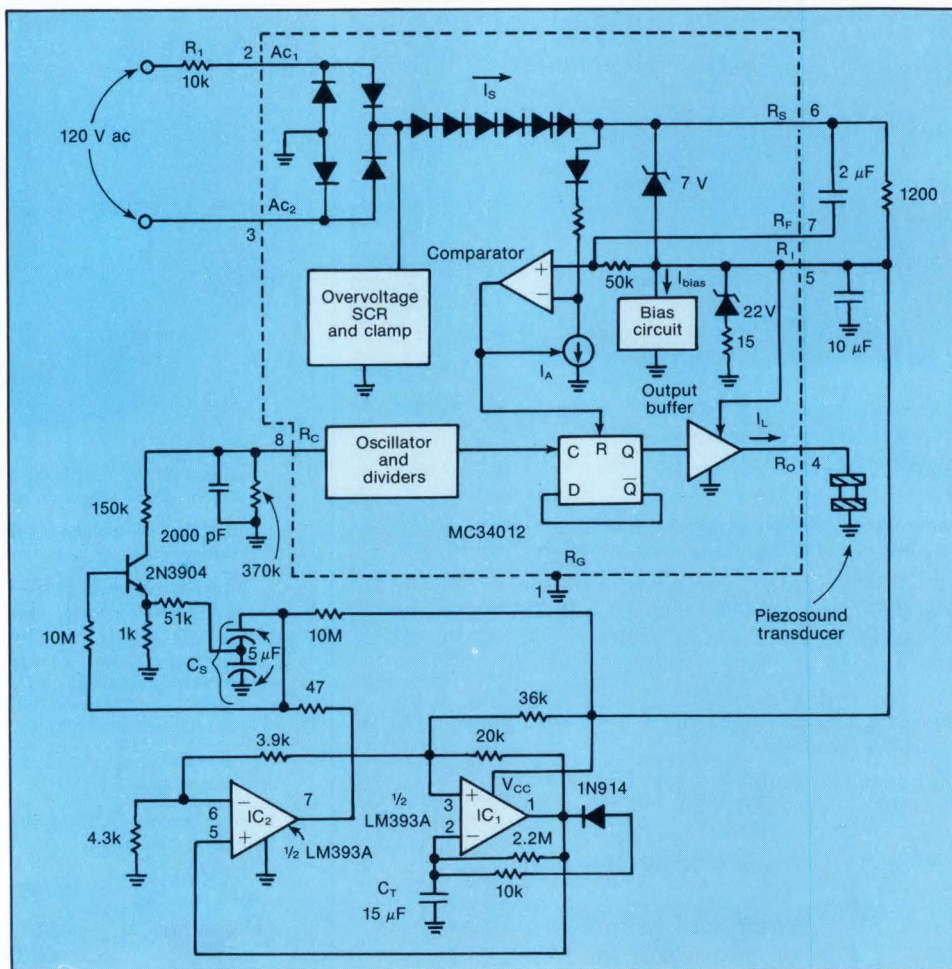
Applications Engineer
Motorola Inc., Semiconductor Products Sector
5005 E. McDowell Road
Phoenix, Arizona 85008

A telephone tone ringer chip makes a potentially less expensive generator of sounds for video games and toys than do chips designed for those special effects. The circuit's internal oscillator frequency can easily be

Borrowed from its original application, a tone ringer IC becomes a low-cost alternative to dedicated special-effects chips for swept-frequency sounds. The sweep rate is determined by capacitor C_S , the period by C_T . Care should be exercised in construction since 120 V ac is applied directly to the circuit.

varied to produce a swept-frequency sound.

Capacitor C_S in the circuit (see the figure) determines the sweep rate of the sound generator, and capacitor C_T sets the repetition rate. One half of a dual comparator, IC_1 , is wired as a free-running oscillator with its frequency set by C_T . IC_1 turns the other comparator, IC_2 , on and off. When IC_2 is high, it allows C_S to charge and simultaneously turns on the 2N3904 transistor, thus varying the equivalent resistance at the tone chip's oscillator input (pin 8). That causes the frequency of the oscillator to vary



Microprocessor programming made simple.

"Keep it simple" was the principle of the 14th Century English philosopher William of Occam and it has even more validity today. Faced with the problems of sophisticated computer systems, designers have found that ever more complex programming languages are further complicating their tasks. Until now.

Occam. Created for system design and implementation.

When we started designing our new VLSI family of 10-MIP transputers, we built on William's simple philosophy. To take advantage of the possibilities opened up by the transputer, we needed to create a language capable of properly addressing parallelism and multiprocessor systems.

With the ability to describe concurrency (whether timeshared or real) and to handle message-passing at the lowest level of the language, all aspects of a system can be described, designed and implemented in occam. From interrupt handling through signal processing to screen editors to artificial intelligence. And on.

But occam is not limited to our

transputer family. It provides an efficient, responsive implementation language for systems built on today's microprocessors. It also opens up future possibilities with its performance-enhancing multiprocessor capabilities. And INMOS now offers a product to let you exploit occam's total capability in your system.

Simplify your job with the Occam Programming System.

The Occam Programming System (OPS) gives you the tools for complete VAX / VMS software development. This package includes an integrated editor / checker, an optimizing VAX compiler and full documentation. This gives you a supportive environment for the development of occam programs

for execution on the VAX. Cross-compilers for 68000 and 8086-based systems will also be available.

What's more, the occam programs developed and proven on the OPS will give you a head start for work with the INMOS transputer. Extensions to the OPS will be available which will allow occam programs to run on the transputer.

And if you have a requirement to program the transputer in other popular high-level languages, other extensions will include compilers for C, Fortran, and Pascal.

Get started today.

Contact us for our information pack on occam, the Occam Programming System and the transputer. You'll be surprised how simple your life can be.

For quick response, call us at (303) 630-4000 or write: Occam, P.O. Box 16000, Colorado Springs, CO 80935.



inmos, and occam are trademarks of the Inmos Group of Companies

**See us at WESCON
October 30 - November 2
Booth #2665/67**



from low to high over a period of slightly less than 1 second. When IC₂'s output goes low, it discharges C_S and ends the cycle.

Actually, the two stacked capacitors that form C_S, plus a 51-kΩ resistor, create a feedback path from the base drive circuit to the resultant

emitter current, producing an unusual sweeping sound that differs somewhat from that obtained with a single capacitor. The sound circuit, which is powered directly by the 120 V ac power line, delivers its output to a piezoelectric transducer.

Bus adapter connects two-wire peripherals to three-wire VMEbus

Joe Bricch

Applications Engineer
Advanced Micro Devices Inc.
901 Thompson Place, Sunnyvale, Calif. 94086

Programmable array logic (PAL) devices solve a tricky interfacing problem by connecting the VMEbus to standard peripheral devices—such as CRT, network, and hard-disk controllers—that can also act as bus masters. The PAL devices (see the figure) arbitrate signals traveling between the VMEbus's asynchronous three-wire handshaking protocol and the peripheral chip's two-wire HOLD/HLDA handshaking scheme. The design can be used for parallel serially daisy-chained peripheral chips.

The arbitrating PAL device, here a PAL-

16H8, converts the peripheral devices' HREQ and HACK signals into the BR, BG, and BGACK signals of the VMEbus. The bus-exchange flow charts for the VMEbus, plus the specifications for the processor, determine how the arbitration logic must be connected.

In operation, the $\overline{BR}$ line is asserted if HREQ is active and arbitration has not started. Arbitration is indicated when $\overline{BG}_{in}$ is low. Alternatively, the $\overline{BR}$ line is asserted if HREQ is active and the microprocessor has not completed its current operation. At the appropriate moment, the processor asserts $\overline{BG}$, and that signal then propagates through the BG_{in}/BG_{out} daisy chain. The BG_{out} line stays high only for the device that has actually requested the bus. The $\overline{BGACK}$ line is forced low to indicate that priority resolution is complete and that the bus is busy.

For proper operation of the circuit, $\overline{BR}$ must

PAL16H8 programming for VMEbus arbitration logic

/AS	HREQ	/BGI	NC	NC	NC	NC	NC	/BGACKI	GND
/BCLR	/BGO	BGACK	BR	NC	NC	HACK	NC	NC	VCC
BR = HREQ*/BGI*/HACK + HREQ*BGI*AS*BR									
BGACK = BR*/BGACKI*/AS*BGI + HREQ*/BCLR*BGACK									
HACK = BGACK									
/BGO = /BGI + BGACK + BR									

SPEED AND CONTROL. THE RIGHT STUFF!



AIE's CS Core brings you the industry's most precise regulation of output voltage.

With AIE Magnetics' new CS Core—and our Dash-Bak service—you've got the right stuff you need to take on big-league designs: fastball speed plus pinpoint control.

The CS Core, developed by AIE engineers Charles Conley and Ken Steinbrecher, improves your control by enabling you to regulate output voltage in switch mode power supply transformers more precisely than ever before—with partial turns as small as $\pm 1/6$ turn. That helps keep many design problems from ever getting to first base. And, with Dash-Bak, you've also got speed. We ship sample quantities of "straight-from-the-catalog" items within 72 hours and components that require design modifications within 5 days. So you've got a delivery that's hard to beat.

Find out how our CS Core and Dash-Bak can be a big part of your start-up rotation. Simply write or call us about your next design. We'll gladly send you our catalog and your own Dash-Bak service card. They'll help you stay ahead in the game.

CIRCLE 199

aie
magnetics

"A Division of Vernitron Corporation"

701 Murfreesboro Road Nashville, Tennessee 37210 615/244-9024

DESIGN SOLUTIONS

be delayed for 30 ns after $\overline{BGACK}$. To meet that requirement, HACK rather than BGACK removes BR.

Although the circuit setup shown in the figure uses the PAL16H8, other programmable array logic devices can be used. For example, the 16L8 or the 16R4 are both suitable. However, if other devices are used, the logic would need minor changes (see the program listing, p. 324). Since just a portion of the PAL device is used, which chip is selected depends on the extent of the user's need for additional logic functions. □

Winner for September 6, 1984

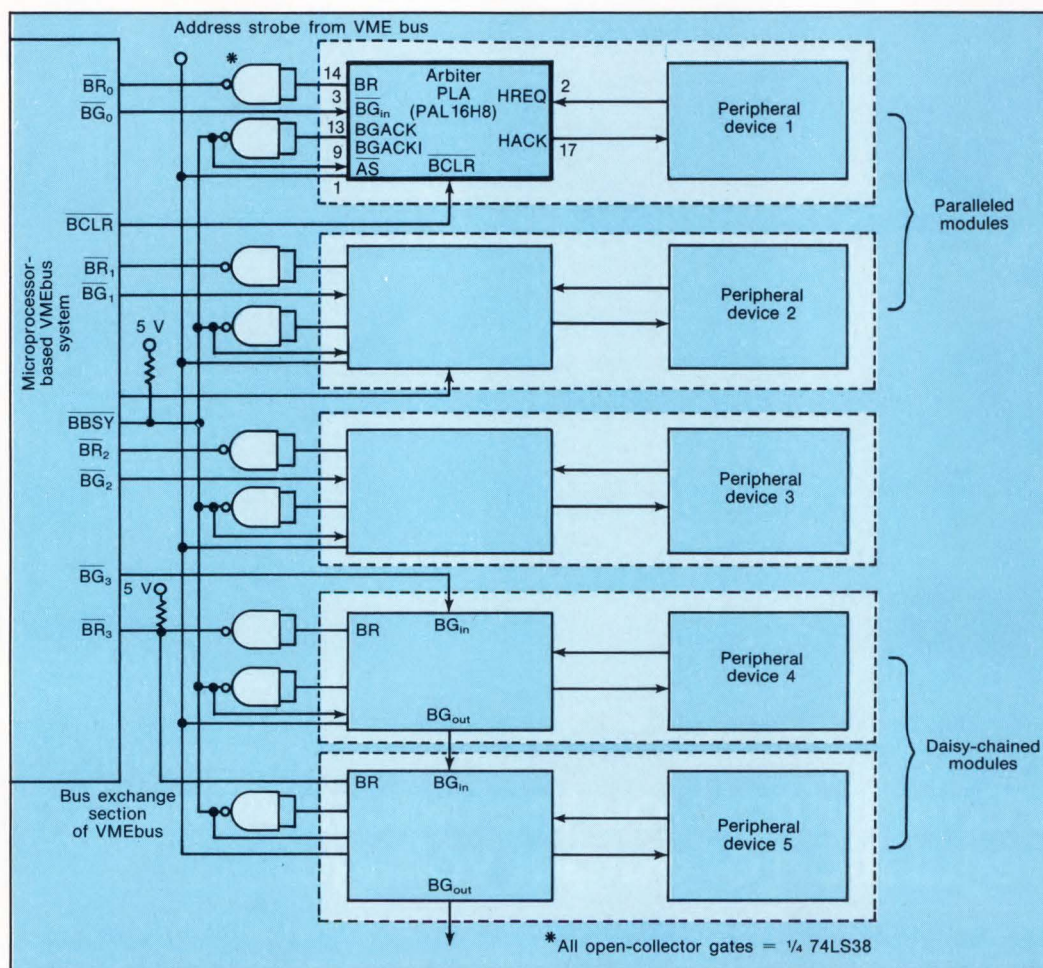
Wide-range oscillator
operates above 20 MHz

Einar Abell, Research Associate, Physics
Department, University of Vermont,
Burlington, Vt. 05405.

Winner for September 20, 1984

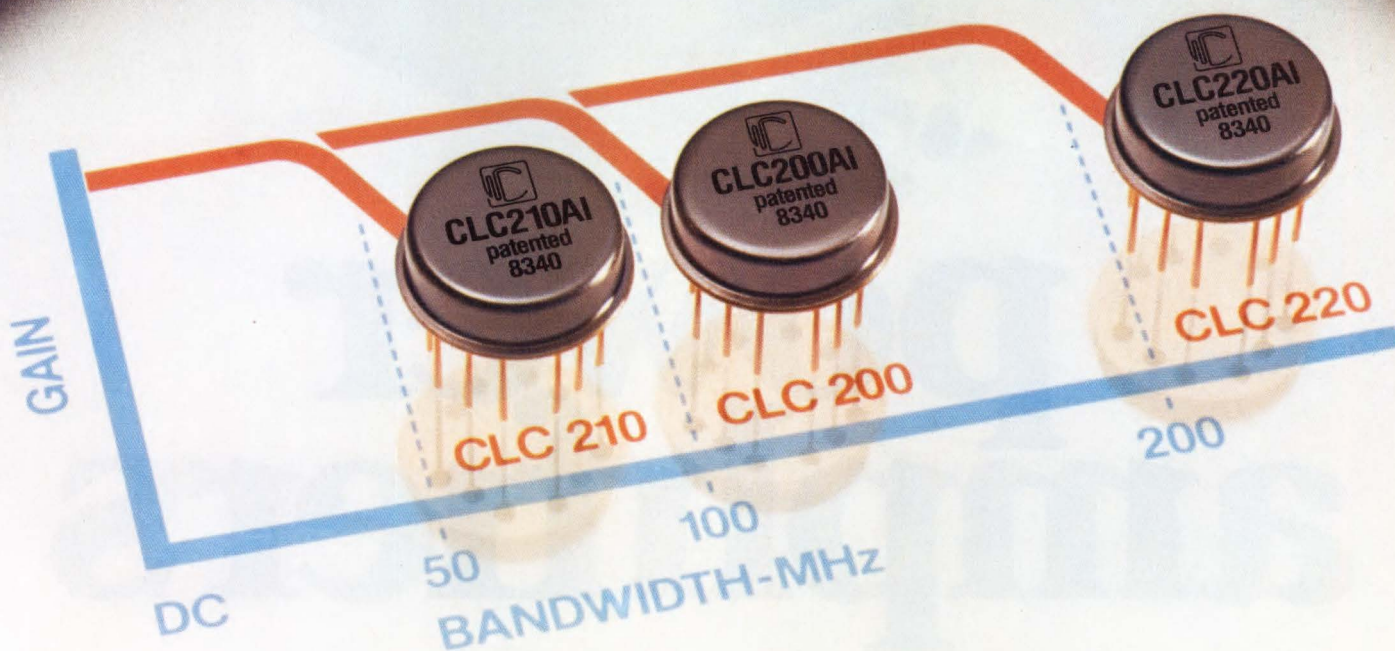
Five-chip circuit converts RS-422
and RS-232-C lines

Charles Alan Mitchell, Test Engineer, United
Technologies Com Dev Inc., 2006 Whitfield
Industrial Way, Sarasota, Fla. 33580.



A programmable logic array (highlighted) converts the two-wire HOLD/HDLA handshaking protocol into the VMEbus's three-wire scheme. The circuit facilitates the use of many peripheral chips, such as DMA and CRT controllers, which can act as masters as well as slaves.

From the innovative leader in
high speed operational amplifiers...



Three more revolutionary op amps that give you maximum performance with minimum design effort.

For designs that require high speed operational amplifier performance, the Comlinear 200 Series is your one-step solution.

The CLC200. Exceptional settling time. Superior thermal tail characteristics.

Consider first the new CLC200. Its DC to 100MHz -3dB bandwidth remains virtually unchanged over inverting and non-inverting gain settings of 1 to 50. Add to that a rise time of 3.6nsec and a settling time of 25nsec to 0.02% with $<1\text{mV}$ thermal tail, and you can see why the CLC200 is the natural choice for any application involving high-speed pulsed information. Not only is the CLC200 fast, but it also has ample drive capability ($\pm 12\text{V}$, $\pm 100\text{mA}$) to remain

oscillation-free even when looking into the high and widely varying capacitance of a flash A to D converter.

The CLC210. 60Vpp output.

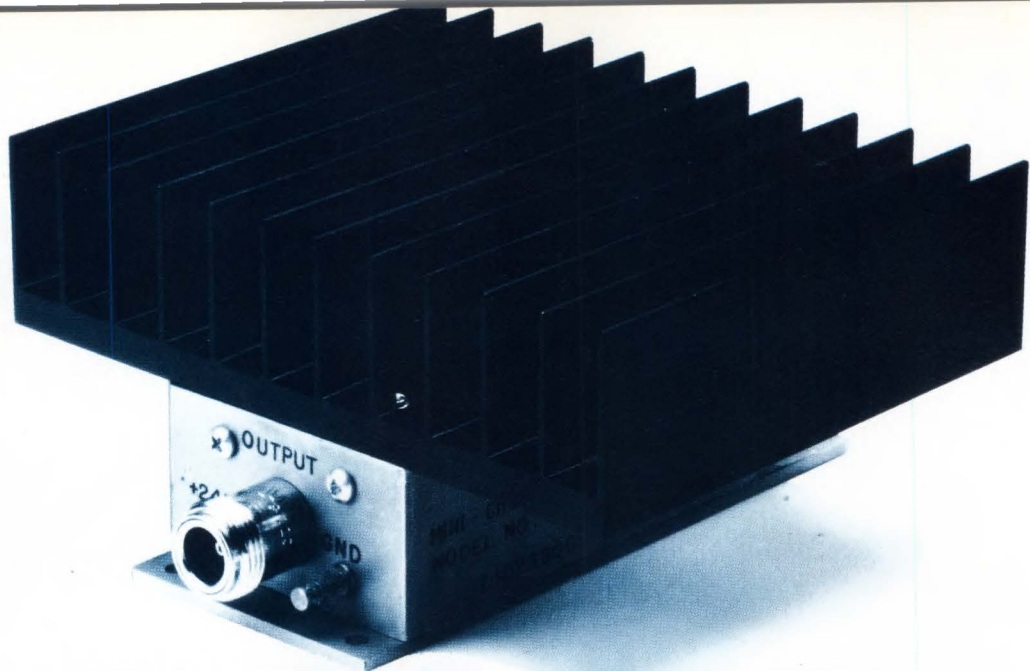
If you're designing high-resolution displays you're probably resigned to designing your own custom driver amps as well. Not any more. The CLC210 is the second member of our new family. It features DC to 50MHz bandwidth, greater than 5MHz full-power bandwidth (at 60Vpp) and a powerful $\pm 30\text{V}$, $\pm 50\text{mA}$ drive capability. Comlinear's drop-in ease-of-use lets you forget about re-inventing the amplifier, and concentrate instead on improving display technology. The CLC210's unparalleled full power bandwidth and high output voltage also make it an excellent choice for directly driving varactors in VCO control loops and phase-correction loops.

The CLC220. Speed and bandwidth redefines the state of the art.

For DC to 200 MHz, rely on the CLC220. With exceptional speed characteristics of 1.6nsec rise/fall times, $8000\text{V}/\mu\text{sec}$ slew rate, and 12nsec settling time to 0.02% (with $<1\text{mV}$ thermal tail), the CLC220 defines the state of the art in high-speed operational amplifiers. Use it with ease and confidence in applications from data conversion, fiber optics, and more.

Look into the Comlinear 200 Series high performance operational amplifiers. All are priced below \$100 in 100-piece quantities. For the full story, call or write us today. Comlinear Corporation, 2468 East 9th Street, Loveland, CO 80537 (303) 669-9433.

 Comlinear
Corporation



power amplifiers

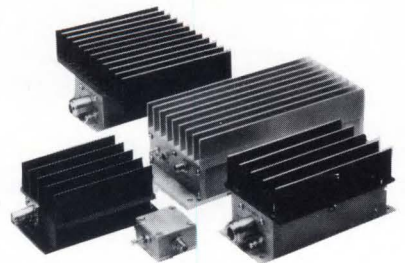
up to 2 Watts linear output
50 KHz to 4200 MHz from \$199

If your application requires up to 2 watts for intermodulation testing of components . . . broadband isolation . . . flat gain over a wide bandwidth . . . or much higher output from your frequency synthesizer or signal/sweep generator . . . Mini-Circuits' power amplifiers will meet your needs, at low prices.

These ultra-linear Class-A amplifiers are unconditionally stable and can be connected to any load impedance without amplifier damage or oscillation.

For low power (50 mW), 22dB gain and 40dB isolation, consider the ZFL-2000; for operation up to 4200MHz with 1-watt output, specify the ZHL-42.

So select the amplifier for your application from the chart below. We'll ship in one week, with, of course, our one-year guarantee.



Model No.	Freq. MHz	Gain dB	Gain Flatness dB	Max. Power Output 1dBm Compression	Noise Figure dB	Intercept Point, Typ. 3rd Order	DC Power Voltage	DC Power Current	Price \$ Ea.	Qty.
ZHL-32A	0.05-130	25 Min.	±1.0 Max.	+29 dBm Min.	10 Typ.	+38 dBm	+24V	0.6A	199.00	(1-9)
ZHL-3A	0.4-150	24 Min.	±1.0 Max.	+29.5 dBm Min.	11 Typ.	+38 dBm	+24V	0.6A	199.00	(1-9)
ZHL-1A	2-500	16 Min.	±1.0 Max.	+28 dBm Min.	11 Typ.	+38 dBm	+24V	0.6A	199.00	(1-9)
ZHL-2	10-1000	15 Min.	±1.0 Max.	+29 dBm Min.	18 Typ.	+38 dBm	+24V	0.6A	349.00	(1-9)
ZHL-2-8	10-1000	27 Min.	±1.0 Max.	+29 dBm Min.	10 Typ.	+38 dBm	+24V	0.65A	474.00	(1-9)
ZHL-2-12	10-1200	24 Min.	±1.0 Max.	+29 dBm Min.	10 Typ.	+38 dBm	+24V	0.75A	599.00	(1-9)
ZHL-1-2W	5-500	29 Min.	±1.0 Max.	+33 dBm Min.	12 Typ.	+44 dBm	+24V	0.9A	495.00	(1-9)
ZHL-42	700-4200	30 Min.	±1.0 Max.	+29 dBm Min.	7.5 Typ.	+38 dBm	+15V	0.69A	895.00	(1-9)
ZHL-7-2W	600-800	28 Min.	±1.0 Max.	+33 dBm Min.	12 Typ.	+43 dBm	+24V	0.9A	525.00	(1-9)
ZFL-2000	10-2000	20 Min.	±1.5 Max.	+17 dBm Min.	7 Typ.	+30dBm	+15V	0.1A	179.00	(1-9)

50 ohm impedance, input and output VSWR 2: 1 max.

Price and specifications subject to change without notice.

Refer to EEM and Gold Book for detailed specs.



finding new ways . . .
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers

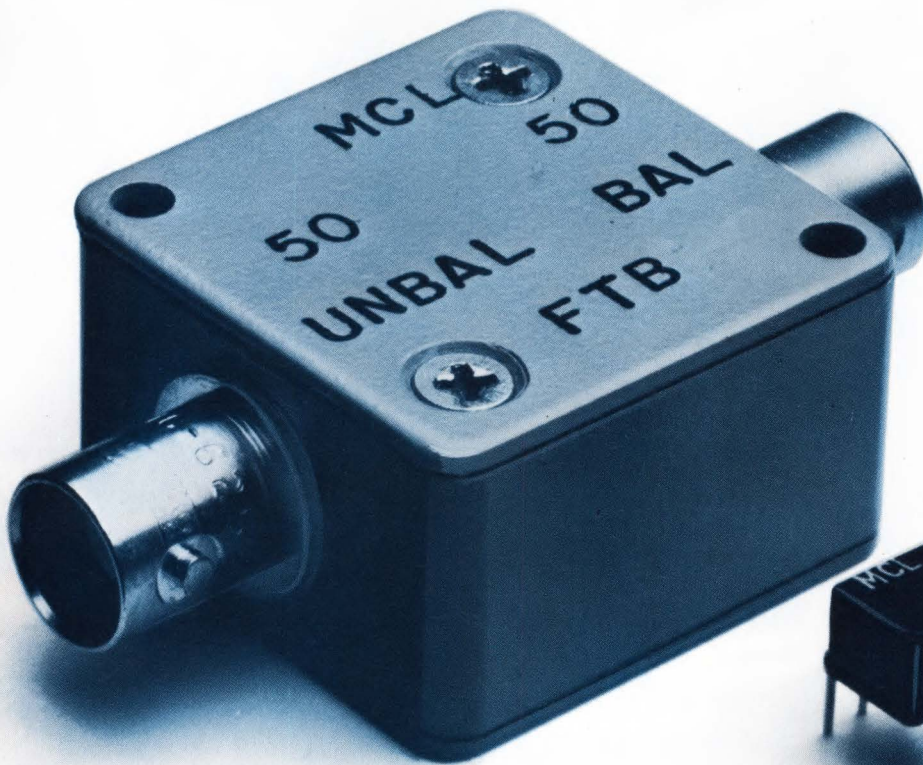
P.O. Box 166, Brooklyn, New York 11235 (718) 934-4500

Domestic and International Telex 125460 International Telex 620156

CIRCLE 126

C70 REV. B

RF transformers

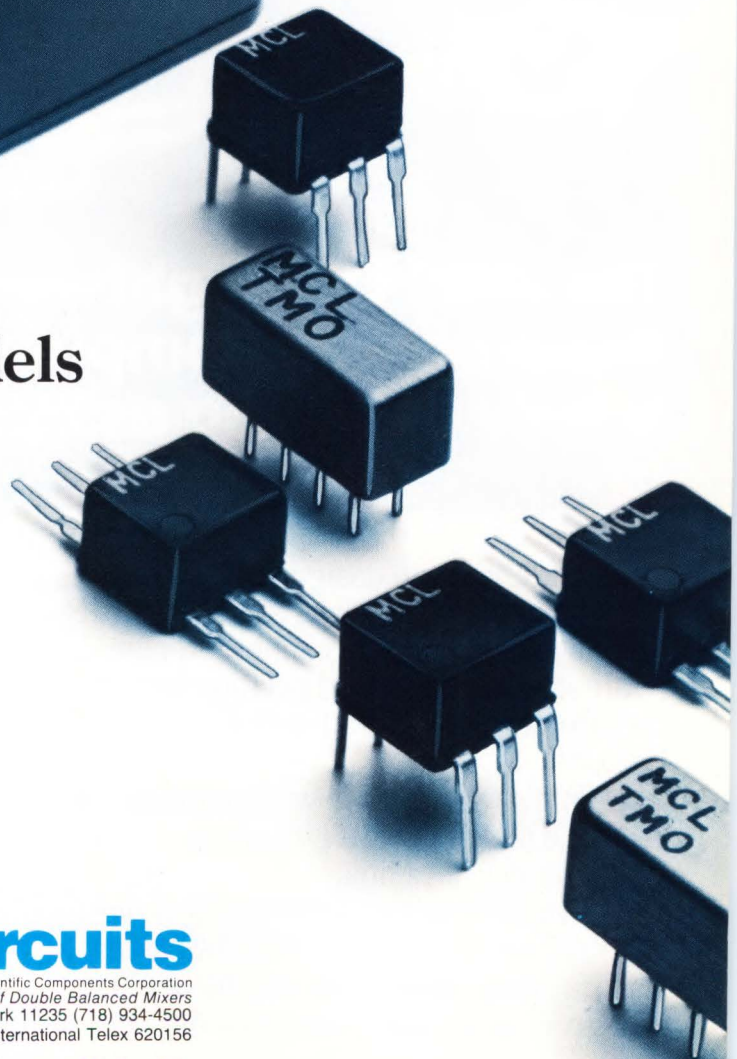


3 KHz-800 MHz
over 50 off-the-shelf models
from \$295

Choose impedance ratios from 1:1 up to 36:1, connector or pin versions (plastic or metal case built to meet MIL-T-21038 and MIL-T-55831 requirements*). Fast risetime and low droop for pulse applications; up to 1000 M ohms (insulation resistance) and up to 1000V (dielectric withstanding voltage). Available for immediate delivery with one-year guarantee.

Call or write for 64-page catalog or see our catalog in EBG, EEM, Gold Book or Microwaves Directory.

*units are not QPL listed



finding new ways...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
P.O. Box 166, Brooklyn, New York 11235 (718) 934-4500
Domestic and International Telex 125460 International Telex 620156

CIRCLE 203

C71 Rev. Orig.



The AT&T ODL™ Lightwave Data Link: because your computer's performance is only as strong as its data link.

Today, you can design the most sophisticated computer hardware imaginable. But if the system elements cannot interface at optimum data rates and performance levels, the effectiveness of your computers could be lost.

That's why we're now introducing the AT&T ODL™ Lightwave Data Link: *the* high performance data link.

A product of the outstanding design capability and experience of AT&T Bell Laboratories, these state-of-the-art links will grow with your customers' data com-

munications needs. With data rates up to 200 Mb/s, low transmission losses and low error rates, our data links will assure your computers' ability to meet the future.

And AT&T offers the complete system. This includes all the required components—from the transmitter, through the cable and associated connectors and hardware, to the terminating receiver. You also get the commitment to customer support and user training services you'd expect from the leading name in communications. Let us help you design a computer system with built-in



© 1984 AT&T Technologies, Inc.

growth, not obsolescence. For more information, write: AT&T, Dept. CG, 555 Union Blvd., Allentown, PA 18103, or call 1-800-372-2447. In New Jersey, call 201-631-6790.



**AT&T, Dept. CG, 555 Union Boulevard
Allentown, PA 18103**

- ☐ Please send me information on AT&T ODL™ Lightwave Data Links.
☐ Let me know how I can get a 40 Mb/s Data Link models kit.

Name (please print) Title

Company

Address

City State Zip

CIRCLE 204



Break Tradition

In the summer of 1983, a group of irreverent Australians blew 132 years of yachting tradition out of the water. They came to Newport with an innovative idea in keel design. They went home to Perth with the America's Cup.

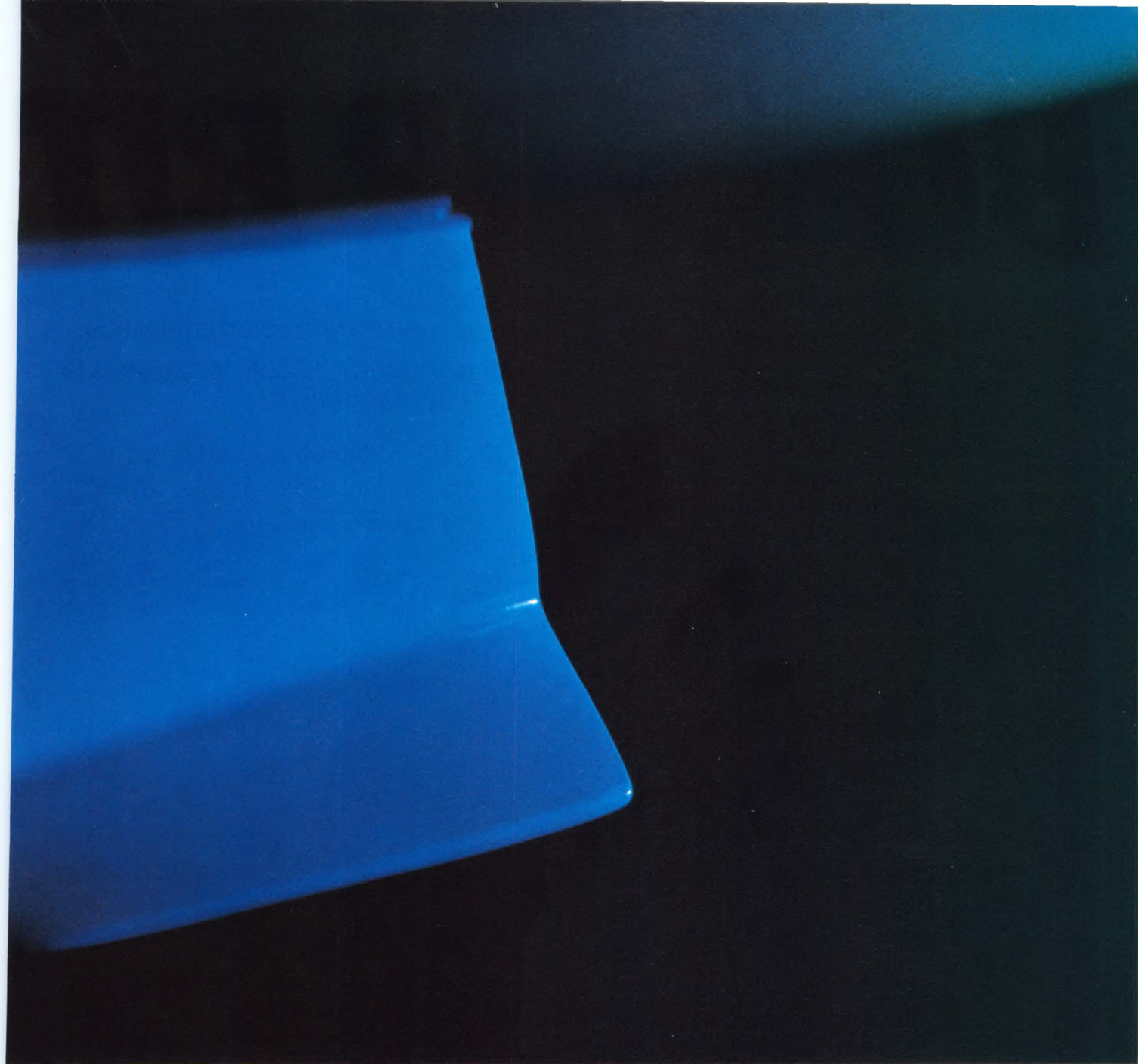
Traditions die hard in the microwave industry, too.

So if you've traditionally purchased the "other" brand of microwave counter without really comparing performance and reliability, you'll discover that design innovation has also turned *your* industry around—that there are better, easier, more expert ways to measure microwave frequencies.

OUR TRADITION-BREAKING CHALLENGE

A standard EIP 545A will outperform your standard HP 5342A¹ in a side-by-side comparison, or we'll give you the brand new 545A. FREE.

Yes, that's right. In a side-by-side demonstration with your HP 5342A, you'll discover that the 545A's 5 watt power handling virtually eliminates front end burn-out and, at the same time, delivers -30 dBm sensitivity. You'll also discover that the 545A's superior frequency selectivity gives you *absolute confidence* in measuring the signal you want to measure in the presence of many spurious signals.



For a free, large size poster suitable for framing, circle the number below.

In short, an EIP 545 will outperform an HP 5342A, considering the crucial performance areas of power handling with excellent signal sensitivity, and frequency selectivity in the presence of multiple signals.

Plus, more than 1000 EIP 545A counters with 2.7 million operating hours have a demonstrated MTBF of greater than 26,200 hours. That means, based on a standard work week, you get an instrument backed by 12.6 years of trouble-free operation!

Don't take our word for it. But at the same time, don't compromise your expertise by clinging to old habits for the sake of tradition. Write to John Tarvin, Product Manager, on your letterhead to arrange for a demonstration. But act quickly, your letter must arrive before November 1, 1984.* EIP Microwave, Inc., 2731 North First Street, San Jose, CA 95134.



The EIP 545A. If you've traditionally purchased any other microwave counter without comparing performance and reliability, we're here to turn you around.



¹ HP and 5342A are registered trademarks of Hewlett-Packard Corporation

* Offer limited to U.S., Canada and Europe

CIRCLE 205

BIPOLAR BIT

Bipolar is on its way to that big computer in the sky.

And it's all because of Zytrex.

Our new CMOS process is just as fast as anything low power Schottky has to offer. And we mean anything.

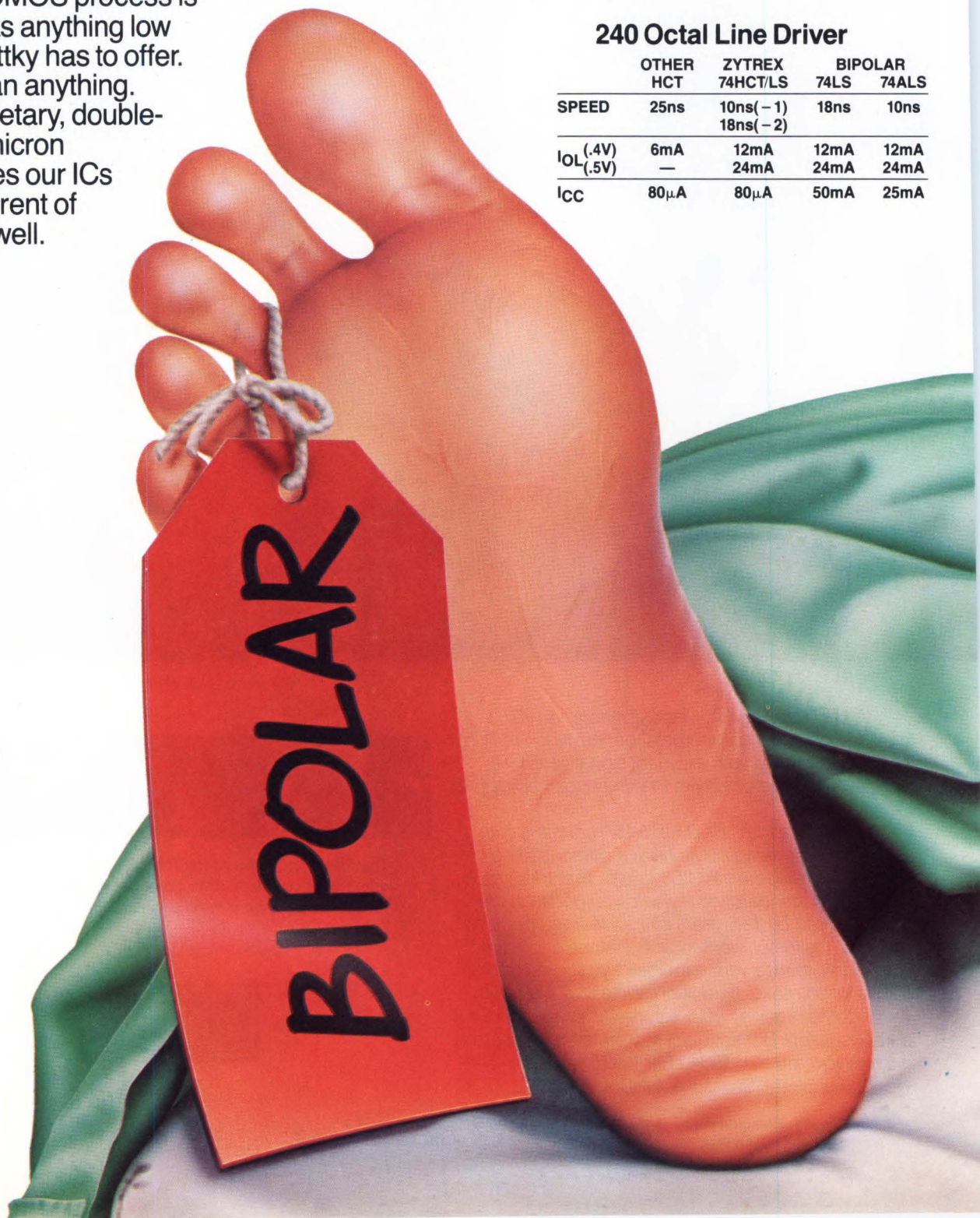
Our proprietary, double-metal, two micron process gives our ICs the drive current of LS/TTL, as well.

All our parts are created equivalent.

Our parts aren't just compatible with LS/TTL. They're equivalent.

240 Octal Line Driver

	OTHER HCT	ZYTREX 74HCT/LS	BIPOLAR	
			74LS	74ALS
SPEED	25ns	10ns(-1) 18ns(-2)	18ns	10ns
$I_{OL}(.4V)$	6mA	12mA	12mA	12mA
$I_{OL}(.5V)$	—	24mA	24mA	24mA
I_{CC}	80 μ A	80 μ A	50mA	25mA



ES THE DUST.

Just plug 'em in and go.

And that goes for our buffers, counters, latches, flip-flops. Even our CALs.™ As for voltage, the only time we use the word pull-up is when we're trying to get the competition off the floor.

So stop kicking a dead technology.

CAL (CMOS Array Logic) is a registered trademark of Zytrex Corporation.

Call 408-733-7703, or write us and ask about our new high-speed, double-metal CMOS.

It'll make your next design come alive.

Zytrex
THE FASTEST CMOS ALIVE.

750 East Arques,
Sunnyvale, CA 94086

CIRCLE 206



Set your design imagination free.

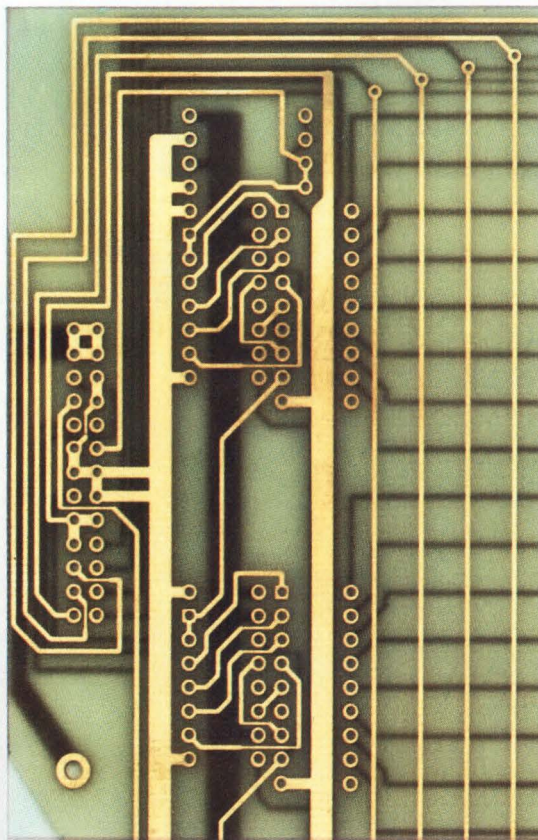
The Interconics Challenge:

You design the large circuit board you've always wanted — we'll produce it!

Our superior capabilities mean you can now design circuits as large as you want, with densities never before possible on large boards. Boards four feet wide by six feet long with 7-mil lines and guaranteed 10-mil edge-to-edge tolerance are nothing new to us.

We routinely work with a host of substrates and laminates. And we hold tight tolerances, even on unstable materials.

High-density, large circuit boards are only the start of the Interconics story. We also produce micro-strip, stripline and phased array antenna circuits and large flexible circuits better than anybody in the world.



Interconics Large Circuit Capabilities

Characteristic	Value
Maximum circuit size	Up to 50" wide; length limited only by availability of materials
Line width	7-mil lines routinely produced on 48" boards
Dimensional tolerance	
Line width and spacing	± 10%
Line position	± 5 mils over 48"
Line straightness and parallelism	± 2 mils over 48"
Front-to-back registration	5 mils

Let us show you what we've already achieved in producing innovative circuit designs. Simply call 1-800-328-9086 (In Minnesota 612-228-6512) or write: Interconics Information Center, P.O. Box 64223, St. Paul, MN 55164. We'll send you a 4-color brochure with all the technical details.



**Finally,
precision, high density
and fine lines on even
the largest circuit
boards.**



Advanced Interconnect Products and Technologies

interconics

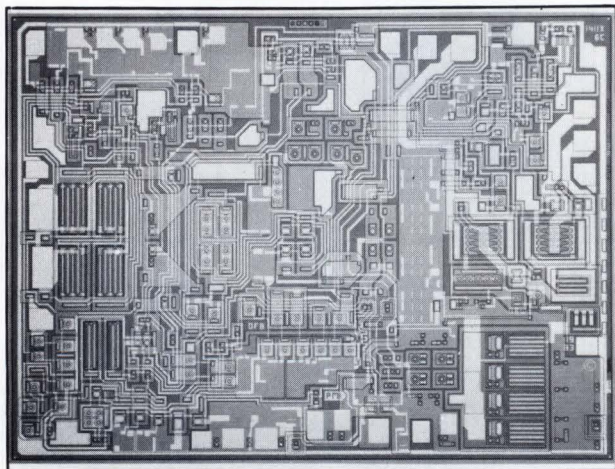
A UNIT OF **BMC** INDUSTRIES, INC.

CIRCLE 207

PRODUCT REPORT

FOCUS ON MONOLITHIC PRECISION OP AMPS

Lower input offset voltage and temperature drift, higher speed and quicker settling time, and increased open-loop voltage gain are among the traits of the latest precision op amp chips.



1. Precision Monolithics' OP-50 boasts an open-loop gain of over 10 million. The thermal symmetry of the die reduces drift and makes possible the chip's high output— ± 50 mA at ± 10 V. Two pairs of cross-coupled superbeta transistors (left center), along with suitable on-chip cancellation circuitry, reduce input bias current to 1 nA.

Because they are the fundamental building blocks of many linear circuits, precision operational amplifiers—defined here as those with offset voltages of less than 1 mV—are being pushed for increasingly better performance. Lower offset errors, improved noise characteristics, and diminished power consumption are just some of the benefits that can be traced to the sure and steady search for the ideal monolithic op amp.

In the past, circuit designers have often been frustrated by the trade-offs forced upon them when selecting a precision op amp. Essential parameters, such as input offset voltage and its thermal drift, input bias current, common-mode and power-supply rejection ratios, and noise, could not all be satisfactorily met in a monolithic device.

FET-input op amps, for example, boasted low biases but were characterized by high drift and excessive noise. Bipolar devices, on the other hand, excelled in offset and drift specifications but did so at the cost of low bias current.

Though still not ideal, the current crop of op amps are strong enough on a number of fronts to make the task of choosing one less arduous. In fact, high-performance op amps such as the OP-07 and OP-27 from Precision Monolithics go a long way toward unseating the workhorses of the last decade: the ubiquitous 741, 301, and 308. Moreover, many companies have the advanced processing technology that allows them to second-source precision parts.

New versions of popular op amps and designs based on CMOS or combined technologies, from companies such as RCA and Linear Technology, clearly show the trend toward the greatly improved specifications that can be expected in the near future.

System requirements will dictate the shape of op amps to come. For now, four concerns are of paramount importance to those involved in designing the components: lowered input offset voltage and temperature drift, reduced input voltage noise in bipolar devices, higher speed and faster settling times, and increased open-

Harold Winard

Focus: Monolithic precision op amps

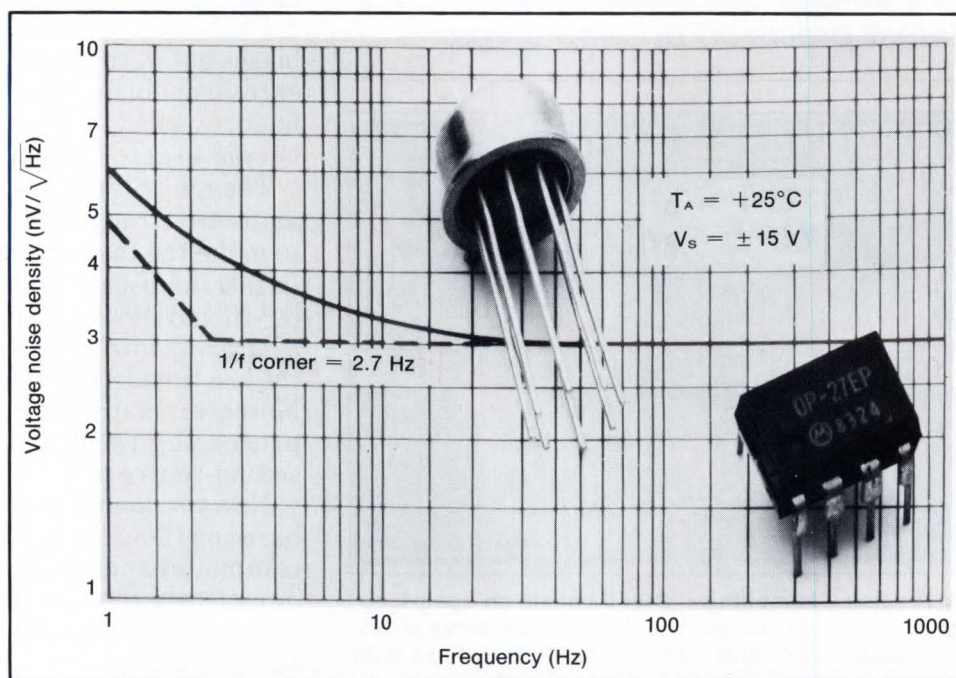
loop voltage gain. Among the other significant specifications being enhanced are input bias current and bias current drift.

Opening the can

The attention paid to op amp parameters is paralleled by an updated look for the devices themselves. The familiar TO-99 can, though still available and sought after for its good shielding, is now complemented by an 8-pin DIP. The change is due, in part, to improved die passivation techniques that boost reliability without the need for expensive hermetic packages. And just as automatically insertable DIPs are standing in for metal cans, surface-mounted devices promise to be the packaging technology of the near future. Further, precision op amps will be available soon in small-outline housings that are especially attractive for very densely packed and stacked boards.

Exemplifying the improved abilities of op amps is the OP-50, whose output stage delivers as much as ± 50 mA (giving the device its model number) at up to ± 10 V. Introduced by Precision Monolithics, the originator of a host of industry-standard parts that include the OP-07 and OP-27, the OP-50 features open-loop gain to over 10 million, lowered input bias current, and boosted output drive—all without increasing noise or sacrificing dynamic performance (Fig. 1). Its input offset voltage is approximately $20 \mu\text{V}$, about the same as the OP-27's, but the input bias current has been cut to ± 1 nA, significantly lower than its forerunner's ± 12 nA. Further, the chip's single-supply capability—either 15 V or 28 V—makes it adaptable to a wider variety of circuits.

For closed-loop gains above 50, the chip is quite stable. If gains from 5 to 50 are demanded, however, the op amp can be externally compen-

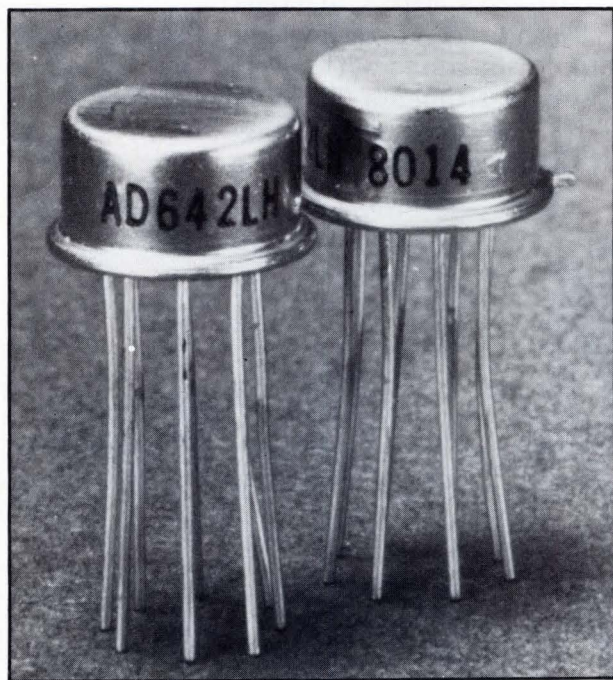


2. One alternatively sourced OP-27 from Motorola boasts low noise. Noise voltage density is $3.8 \text{ nV}/\sqrt{\text{Hz}}$ at 1 kHz and $5.5 \text{ nV}/\sqrt{\text{Hz}}$ at 10 Hz.

sated. A rugged chip, the OP-50 comes with current-limiting resistors on its input, as well as protection diodes.

Another amplifier that takes advantage of an earlier design is National Semiconductor's LM11, which capitalizes on the popular LM108A. The descendant, though, offers greatly reduced input bias currents and lower offset voltage, 25 pA and 100 μ V, respectively. What's more, an improved version is slated for release early next year and will sport an offset of 80 μ V, a temperature coefficient of 1.5 nV/ $^{\circ}$ C, and a bias current of just 50 pA at 25 $^{\circ}$ C.

Alternative sources for op amps are common, and such parts as the LM11 and LM108 are available from several different manufacturers. In the same vein, Motorola is just one of the suppliers of the aforementioned OP-27, along with Burr-Brown, Analog Devices, and Harris (Fig. 2).



3. Precision dual op amps, the AD642 and AD644 from Analog Devices guarantee a maximum offset voltage of just 0.5 mV once they are warmed up. The individual op amps within each package are matched to within no more than 0.25 mV.

From 0.1 to 10 Hz, the OP-27 exhibits a maximum noise voltage of 0.18 μ V pk-pk, noise voltage density at the input ranges from a high of 3.8 nV/ $\sqrt{\text{Hz}}$ at 1 kHz to 5.5 nV/ $\sqrt{\text{Hz}}$ at 10 Hz. The low-noise characteristics make it a good choice when an instrumentation-grade amplifier is needed for signal conditioning. Its precision input specifications, the result of trimming at the wafer level, include a guaranteed input offset of no more than 25 μ V.

More than just a clone

Exact duplication is not always the goal of alternative sourcing, as Burr-Brown proves in its enhanced version of the OP-27. The OPA27EJ has a minimum common-mode rejection ratio (CMRR) of 114 dB, a maximum offset of 25 μ V, and a drift of 0.6 μ V/ $^{\circ}$ C. Its voltage density is also low—just 3.8 nV/ $\sqrt{\text{Hz}}$.

The wide range of Precision Monolithics' devices that are available from other manufacturers (readily identified by their OP prefix) is another example of multiple sources. Micro Power Systems, for instance, builds its own versions of the popular OP-07 and such successors as the OP-27 and the OP-37. The last has a gain-bandwidth product of 63 MHz, a CMRR of 126 dB, and an offset of only 10 μ V. The chip's good performance is evidenced by its stability over both time and temperature, which come in at 0.2 μ V/month and 0.2 μ V/ $^{\circ}$ C, respectively.

Another PMI part (also alternatively sourced by Micro Power Systems) is the OP-207, a dual op amp that reflects the trend towards multiple amplifiers in a single DIP. Of course, matching is important and very close tracking is ensured for offset voltages, drift, and CMRR. A convenient feature of the OP-207 is the symmetry of its connections, which allows the DIP to be inserted into a socket in either direction.

Two are as good as one

The AD642 and AD644 (Fig. 3) dual biFET op amps, from Analog Devices, offer the precision of their single-device counterparts, the AD542 and AD544. The maximum offset of ± 0.5 mV is matched within the package to within no more than ± 0.25 mV, and offset error over temperature is only ± 1 mV. Tracking is also guaranteed to ± 1 mV.

Tight matching between paired op amps is

PRODUCT REPORT

Focus: Monolithic precision op amps

obvious in another Analog Devices part, the AD647. The maximum offset is within ± 0.25 mV; drift, between $\pm 2.5 \mu\text{V}/^\circ\text{C}$. This is by far the lowest offset voltage and offset drift of any biFET. Additionally, the maximum bias current of 35 pA is also matched—to within ± 25 pA. The AD647 comes in a TO-99 can, rather than an 8-pin DIP, so that the necessary terminals are available for offset nulling.

Two in for one out

A unique twist on multiple devices is seen in Burr-Brown's switchable-input op amp, dubbed the Swop Amp (Fig. 4). It contains two independent differential input stages and a single output stage. Either of the inputs can be connected to the output by applying an external TTL-compatible signal. Such programmability minimizes hardware requirements and cost.

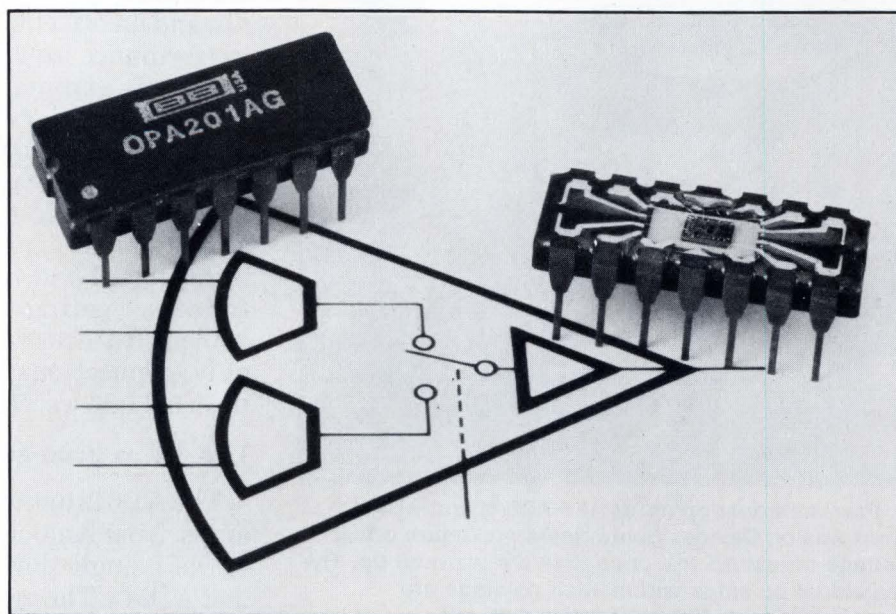
The device's input stages exhibit good performance characteristics. For example, the offset voltage for each is $100 \mu\text{V}$, and their drift just $1 \mu\text{V}/^\circ\text{C}$. In addition to the load, the input stages share the external offset trimming pins, thus simplifying that adjustment.

Functional replacements also simplify engi-

neer's lives, giving them the latitude to upgrade existing circuitry without major design changes. A case in point: RCA's three-member CA3193 series pinch-hits nicely—in applications that do not require nulling—for such industry-standard parts as the LM108A, OP-05, OP-07, and LM11. The military temperature version has an input offset of just $40 \mu\text{V}$ and displays a drift of just $0.6 \mu\text{V}/^\circ\text{C}$ over that range. The device is an example of a technology, called BiMOS, that mixes PMOS and bipolar transistors on the same chip.

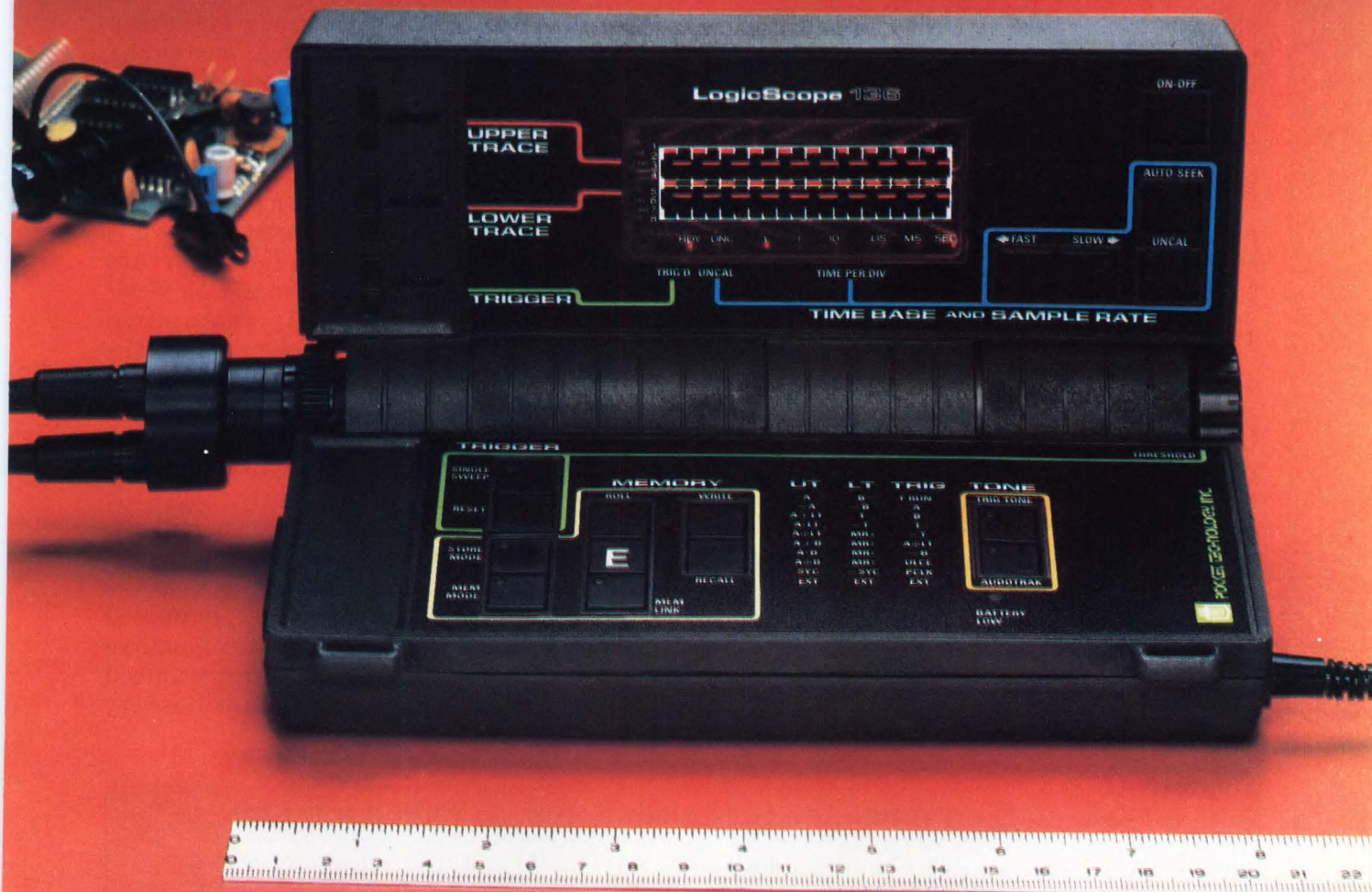
BiMOS is also employed in RCA's CA3493 op amps. All very stable devices with minimum gains as high as 120 dB, the chips are good choices for thermocouple preamplifiers, strain-gauge bridge amplifiers, and high-gain filters. Beyond their improved performance, the devices are pin-compatible with a variety of other operational amplifiers, including the OP-05, OP-07, 725, LM108A, and LM714.

The marriage of technologies also has yielded bipolar op amps with JFET inputs, such as Texas Instruments' TL087, TL088, TL287, and TL288. Matched high-voltage JFETs are used at the input and contribute a high impedance



4. With a TTL control signal, the user of Burr-Brown's OPA201 op amp can switch the device to one of two independent input stages. Dubbed the Swop Amp, the part delivers input offsets of $100 \mu\text{V}$ and drifts just $1 \mu\text{V}/^\circ\text{C}$.

Meet Our New LogicScope 136. ... A True Dual Trace 10 MHz Digital Storage Scope. Only \$495.



True Dual Trace • 10 MHz Real Time Bandwidth • 3 Input Channels • I/O Port
Digital Waveform Storage • Boolean Waveform Operations • Audio Functions
8.25 (L) x 4.5 (D) x 1.75 (H) Inches • 1.25 Pounds • 9 Volt Battery/AC Operation

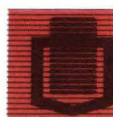
Consider the LogicScope 136

- The LogicScope 136 is the next logical step in test instrumentation for you. It combines many of the features and capabilities of sophisticated logic analyzers and oscilloscopes... and it fits in your hand. Never before has so much technology been available in so small an instrument, at such a low price.
- The pocket-sized LogicScope 136 is made possible by a patented breakthrough in display technology. The conventional cathode ray tube has been replaced by a unique array of 400 LED's that permits simultaneous display of two digital waveforms.
- The 136 can be used for viewing single shot events, or repetitive waveforms. It can be operated in real time mode, or in memory mode which permits acquisition and storage of up to 24 128-bit waveforms. These can be recalled, logically compared (AND, OR, EXCLUSIVE OR) to other stored/input waveforms, or output to an external device via an RS 232 port.
- Its very low cost, convenience and ease-of-use make the LogicScope the ideal instrument, for designing, troubleshooting or repairing digital systems.

Consider its Engineering & Field Service Applications:

- On microprocessor-based systems, check the timing relationship of various parameters relative to the system clock and other key events. Its storage capability allows visual and logical comparison of non-repetitive waveforms to known reference signals. Output in the start-up of the digital device can be compared to reference signals to determine the operating state of the device. Questionable waveforms can be stored for analysis.
- Its light weight and small size make the LogicScope convenient to take on every service call. The 136 provides much more information for trouble shooting a digital system or peripheral than a logic probe or digital multimeter, without having to lug an oscilloscope or logic analyzer along.

Contact us for the name of your local distributor



POCKET TECHNOLOGY, INC.
7320 Parkway Drive, Hanover, MD 21076
301-796-3300

PRODUCT REPORT

Focus: Monolithic precision op amps

plus a low offset—0.5 mV. The slew rate is high, typically 13 V/ μ s, and the input bias current is low, typically 30 pA.

A low bias current op amp, the OPA100 from Burr-Brown, also goes with a JFET input. The chip is suited to precision voltage amplification in high-input-impedance applications, such as pH electrodes and biological probes. Among its specifications are a maximum voltage drift of 5 μ V/ $^{\circ}$ C and a maximum offset of 250 μ V.

The sum of the parts

FETs and bipolar parts combine in Harris Semiconductor's HA-5170 precision op amp. Laser trimming helps reduce the input bias current to 20 pA. That specification, along with the chip's low offset of 100 μ V, makes the device a good choice for transducer signal amplification and precision data acquisition. Further, its 8-V/ μ s slew rate and 5-MHz bandwidth extend the latitude of precision instrumentation applications.

Another JFET-input op amp, the HA-5180A, offers what Harris states is the lowest input bias current available in a monolithic device—

typically 250 fA. A notable attribute of the chip is its facility to null the offset bias current by externally adjusting the offset voltage. The latter is typically 100 μ V.

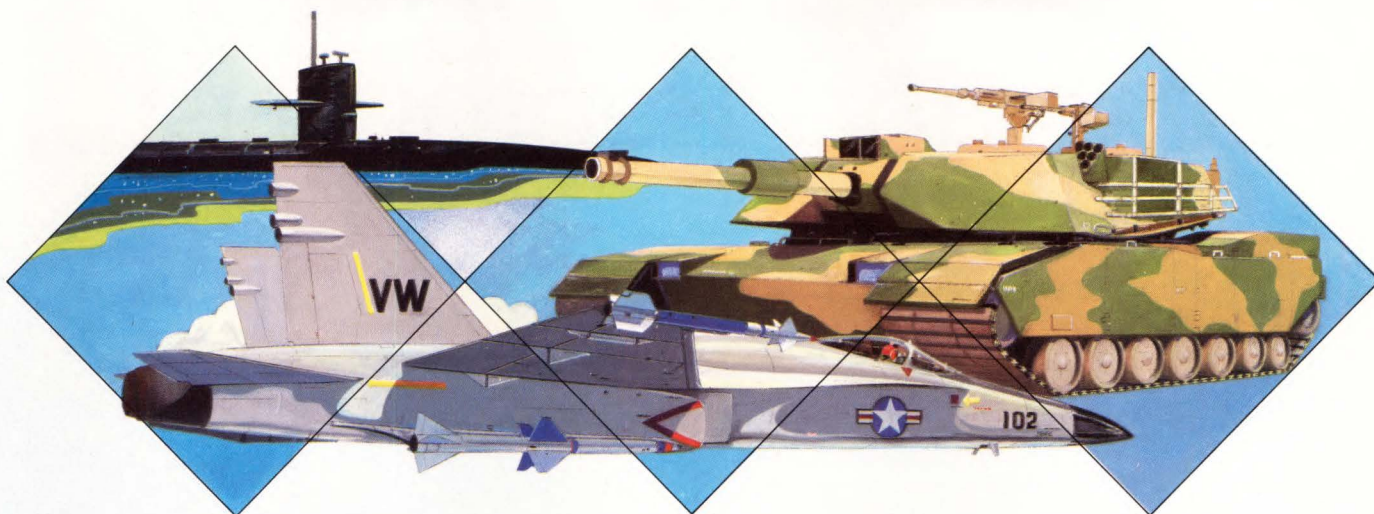
The future bodes well for bipolar op amps, which can be expected to have lower and more stable input bias currents over temperature and less variation due to common-mode voltage. Both improvements hold down errors caused by signal-source resistance. CMOS devices, especially those that incorporate a mixed CMOS and bipolar approach, should be available in greater quantities than they are at present.

Two CMOS op amps can be had now from Linear Technology—the LTC1052 and LTC7652. Both are chopper-stabilized parts that have the appropriate internal and user-transparent circuitry for that function. Intermodulation errors, chopping noise, and overrange lock-up, the company notes, have been virtually eliminated in those devices. The LTC1052 is pin-compatible with the earlier model 7650. It has a guaranteed maximum offset of just 5 μ V and its drift is very low—0.05 μ V/ $^{\circ}$ C. □

Directory of monolithic precision op amp manufacturers

	Circle		Circle
Analog Devices Semiconductor Inc. Wilmington, Mass. (617) 935-5565	451	Motorola Semiconductor Products Inc. Phoenix, Ariz. (602) 244-6900	458
Burr-Brown Corp. Tucson, Ariz. (602) 746-1111	452	National Semiconductor Corp. Santa Clara, Calif. (408) 721-5000	459
Fairchild Camera & Instrument Corp. Mountain View, Calif. (415) 962-5011	453	Precision Monolithics Inc. Santa Clara, Calif. (408) 727-9222	460
Harris Corp. Melbourne, Fla. (305) 727-4000	454	Raytheon Co. Mountain View, Calif. (415) 968-9211	461
Intersil Inc. Cupertino, Calif. (408) 996-5000	455	RCA Corp., Solid State Division Somerville, N.J. (201) 685-6000	462
Linear Technology Corp. Milpitas, Calif. (408) 942-0810	456	Teledyne Semiconductor Mountain View, Calif. (415) 968-9241	463
Micro Power Systems Inc. Santa Clara, Calif. (408) 247-5350	457	Texas Instruments Inc. Dallas, Texas (214) 995-6611	464

Standard MIL-SPEC DC/DC CONVERTERS



Designed, qualified and ready for evaluation.

They're now available! TRI-SERVICE qualified DC/DC converters from Rantec . . . 300, 150 and 75 watt single output ratings, 180 watt dual output ratings and 175 watt triple output ratings. A 20-32 VDC input provides 5, 12, 15, 24 or 28 VDC outputs.

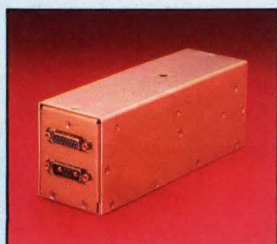
Switching regulation, power MOSFET technology and base plate cooling optimize the efficiency and power density making the converter easy to install in those tight places.

Standard product means you avoid costly non-recurring engineering charges, delays in waiting for

product to develop and ultimately the uncertainty of performance to your specs.

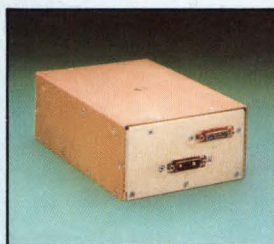
So don't wait 13 to 18 months and spend between \$125,000 and \$300,000 for a custom design.* Rantec's DC/DC converters are already qualified for airborne, shipboard and ground use along with an extensive line of 1 ϕ and 3 ϕ MIL-SPEC DC power supplies. Rantec is the source for MIL-POWER. Call us today for an evaluation unit.

*U.S. Navy/Industry Power Supply Ad Hoc Committee Estimate for Time and Cost.



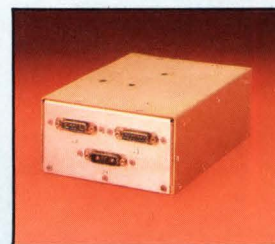
75W Single
5/12/15/24/28 VDC @
15/6.3/5/3.1/2.6A†
7"L x 2.25"W x 2.625"H

150W Single
5/12/15/24/28 VDC @
30/12.5/10/6.3/5.3A†
7"L x 3.5"W x 2.625"H



300W Single
5/12/15/24/28 VDC @
60/25/20/12.5/10.7A†
7"L x 5"W x 2.625"H

180W Dual
 $\pm$ 12/15/24/28 VDC @
7.5/6/3.8/3.2A†
7"L x 4.5"W x 2.625"H



175W Triple
5 VDC @ 20A &
 $\pm$ 12/15/24/28 VDC @
3/2.5/1.5/1.3A†
7"L x 5"W x 2.625"H

†Other V/A combinations available within the same power rating.

CIRCLE 209



Rantec/Power Systems • Division of Emerson Electric Co. • Department DE
9401 Oso Avenue, Chatsworth, CA 91311 • (818) 885-8223 • TWX: 910-493-1247

Finally, CMOS Logic You Can Program, Erase and Reprogram...

The EP300 Breaks New Ground

Altera's EP300 is the first in a family of entirely new products.

The EPLD, erasable programmable logic device, is not an EPROM or a PAL* but an entirely new way for users to program their own logic with greater speed and lower cost than ever before.

Altera EPLD's are an innovative combination of CMOS and EPROM technologies that offer the logic programmability and UV-erasability of EPROM coupled with higher density, lower power consumption and lower overall fabrication costs of CMOS.

No More Penalty for Mistakes

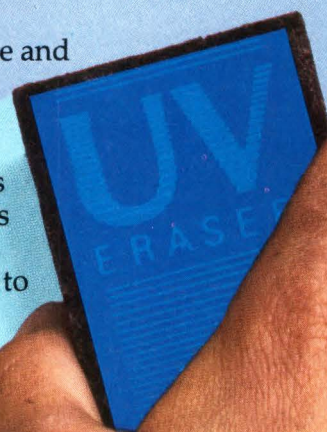
Because the EP300 is erasable, you don't lose time or money when your design has to change.

You can simply erase and reprogram the Altera part right away, right in your own shop.

Erasability also means 100% generic testing is possible and that you don't have to commit to an expensive custom inventory. Altera EPLD's are all standard parts, available through distributors, whether you need one piece or 10,000.

Why bother with expensive gate array solutions when you can cut development time from 6-20 weeks to one day with Altera? Why invest \$10K-\$40K in design costs when you can program your own designs for a one-time investment of \$1,250?

You can maximize board space utility and achieve bipolar speed with a great reduction in power by designing with the EP300. You can also be assured your design is protected, thanks to Altera's exclusive invisible security bit that precludes reverse engineering.



With a System that Saves You Time and Money



The Benefits Accrue from Day One

The Altera logic development system is so strong and so user friendly, you can start appreciating the benefits of user programming from the first afternoon of training. Altera recognized the importance of support tools and developed the proprietary software Logic-Map™ and ALTERANS™ to run on an IBM PC. Not only do you save money on hardware, but

you save time because there is no intensive learning curve.

This self-contained system optimizes device utilization, produces JEDEC files and produces design documentation. Two EP300's are included.

Plus, a Bonus if You Buy Now

If you invest \$1,250 in the Altera logic development system before the end of 1984, you will automatically receive a system upgrade to allow programming of Altera's new EP1200

part to be introduced in 1985 at no additional cost.

This is Altera's way of introducing you to the advantages of the EPLD family and the capabilities of user programmed CMOS logic. You know your next design will require some form of semi-custom logic, so why not use the most advanced product on the market and implement your logic design overnight at virtually no expense?

ALTERA

3525 Monroe Street
Santa Clara, CA 95051
(408) 984-2800 Telex 888496

*PAL is a registered trademark of Monolithic Memories, Inc.

© 1984 Altera Corp.

Distributed by Schweber, Wyle, Pioneer-Standard
at all locations.

CIRCLE 210

FORCE COMPUTERS

System 68000 VMEbus

Single board solutions for 16/32 bit "open systems" in industrial, business, and scientific environments

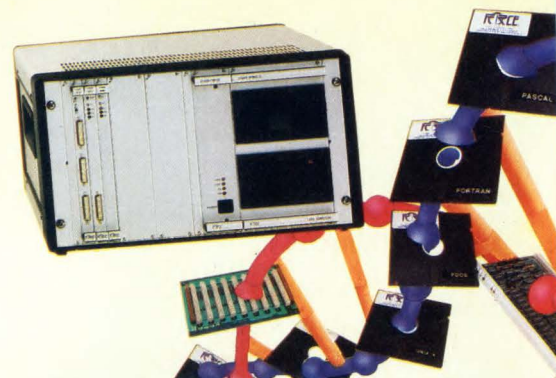
If your application requires advanced technology available in production quantities if quality, reliability, and price/performance ratio are the major criteria for supplier selection – then compare our product portfolio with other alternatives.

- Three CPU's for most applications from intelligent I/O controllers to multiuser/multitasking environments with powerful UNIX* or real time operating software PDOS* and up to 1M byte of on-board memory: CPU-1B, CPU-2, CPU-3.
- Two DRAM Boards: 512KB and 2MB; two SRAM Boards: 128KB and 512KB. RAM/ROM Board: 512KB (max.); DRAM-1, DRAM-2, SRAM-1/2, RR-1/S/E
- Mass memory interface boards with either direct control of up to seven drives (WFC-1) or intelligent VMEbus interface to SASIbus with DMAC (SASI-1).
- Six-channel serial I/O board with Multi-Protocol-Communications-Controller (SIO-1).
- 32-channel parallel I/O boards either optically isolated (1000V) with DMAC (OPIO-1) or TTL-level with 64 mA drive capability signals (PIO-1).
- Intelligent high resolution graphics subsystem (master/slave) with resolution of 1024 x 1024 pixels and up to 12 bits of pixel depth. Powerful graphics operation through local 68000 MPU in parallel with 7220 graphics controller(s) GDC-1M/1S.
- Winchester/Floppy drive modules with up to 80M bytes: WFMOD-20/80.
- Auxiliaries: Backplanes, chassis, power supplies.
- A variety of Software Products, e. g.:
 - PDOS* – Real-Time, Multi-Tasking, with Basic interpreter, Pascal, Fortran 77, and C Compilers.
 - COHERENT* – UNIX* V.7 compatible with C Compiler, Pascal and Fortran 77 in preparation.
- UNIX* – System V, Multi-User, Multi-Tasking.
- In development: memory boards with byte parity and 32 bit addressing; dedicated LAN-Controller; high performance communication I/O.

Supported by a worldwide network of distributors and representatives, FORCE Computers is recognized by its customers (and competitors) as the leading supplier of 68000/VMEbus board products.

*PDOS is a tradename of Eyring Research, COHERENT is a tradename of Mark Williams Co., UNIX is a tradename of AT&T.

Consider, compare, and contact: FORCE COMPUTERS INC.





FORCE COMPUTERS INC.
2041 Mission College Blvd.
Santa Clara, CA 95054
Phone (408) 988-8686
Tlx 172465
Telefax (408) 980-93-31

FORCE COMPUTERS GmbH
Daimlerstraße 9
D-8012 Ottobrunn/München
Tel. (089) 609 20 33
Tlx 524 190 forc-d
Telefax (089) 609 77 93

FIBER OPTIC MULTIPLEXER

Offers noise immunity with complete electrical isolation
at greater data rates and signal distances.



The industry's most versatile multiplexer.

- RS-232C • RS-422 • TTL compatible
- 10 channels of hardwire or optical inputs
- Up to 2 km (6,562 ft.) • Control Lines
- Optional analog and voice inputs
- Low Cost • No fiber optic experience necessary

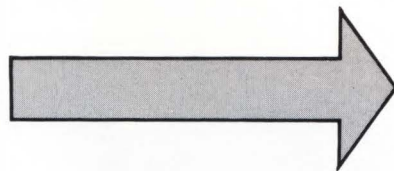


Lightwave Communications, Inc.

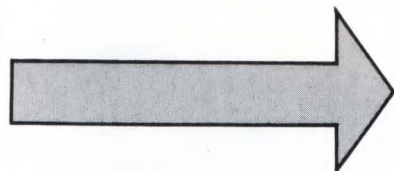
650 Danbury Road, Ridgefield, CT 06877 • (203) 438-3591

CIRCLE 211

ATTENTION POWER SUPPLY SPECIFIERS



See Deltron's New Switching Power Supply Catalog



IF YOUR
COPY
IS MISSING,
CIRCLE
THE NUMBER
BELOW.

Deltron inc.

TOLL FREE: 800-523-2332

P.O. BOX 1369
WISSAHICKON AVENUE
NORTH WALES, PA 19454
PHONE: 215/699-9261
TWX: 510/661-8061

INTERNATIONAL UNIT:

DELAIRE CO.
DUBLIN, IRELAND
TELEPHONE: (01) 851411
TWX: 30442 DEL EI
PREFIXES: UK (0001)
INT. + 353 (1)

CIRCLE 213

20% LOWER COST

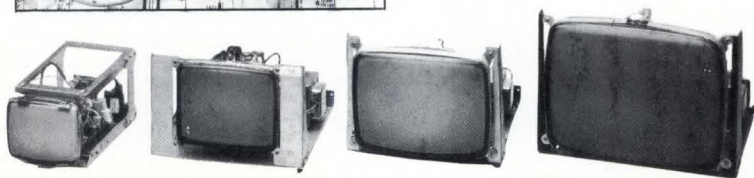
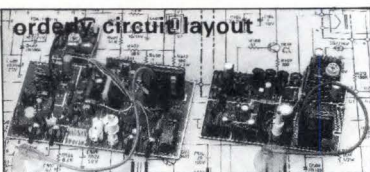


AGC, for years a specialist manufacturer of monitors, can reduce your costs for 5" 7" 9" 12" 14" 15" green, amber, and B/W monitors compared to famous brands. High resolution, good focus 5% or less linearity, orderly circuit layout. OEM and special orders welcome. Contact us for higher profits!

AGC

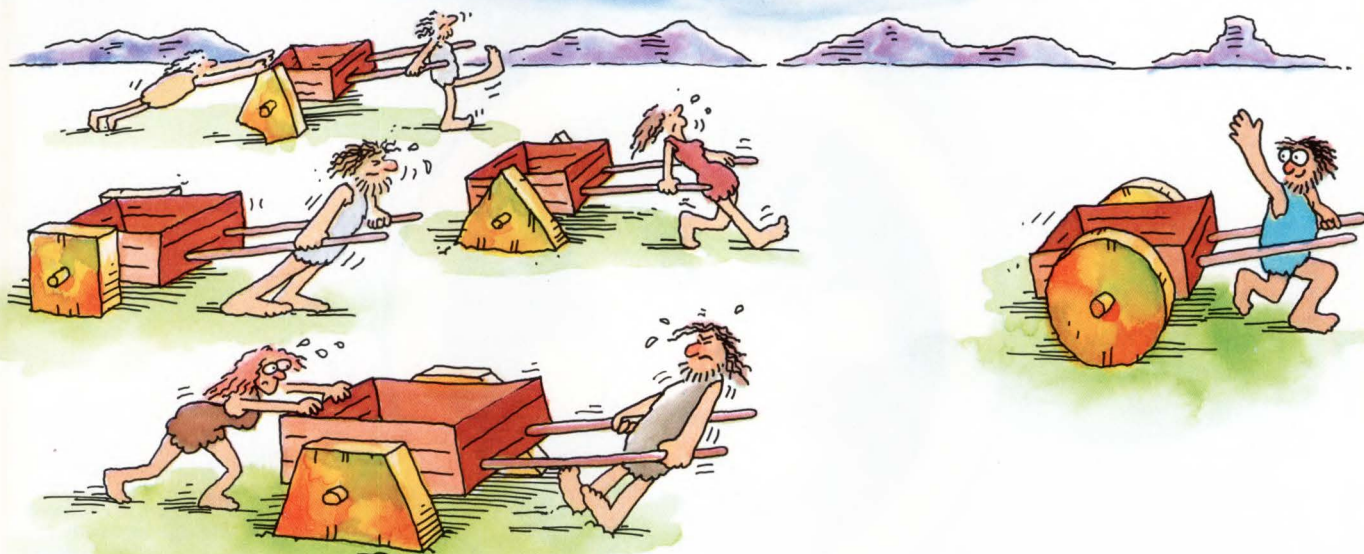
ELECTRONICS CORP.

106, SECTION 3, NAN KANG ROAD,
TAIPEI, TAIWAN, R.O.C. (115)
P. O. BOX: 11464 TAIPEI
TEL: (02) 7602164 (5 LINES)
TELEX: 20726 AGCTPE
CABLE: AGCTPE TAIPEI



CIRCLE 212

All through history, some people have made things better than other people.



THE CLAIM

General Instrument Microelectronics is the best choice for all of your Semicustom needs.

THE TESTIMONY

For some time now, we've been fulfilling the Semicustom needs of our customers, quietly, confidently and with speed and versatility.

One reason for this performance is that all of our services and facilities are "in house." *All* of them. The advantages are immediate and obvious: quicker response to design changes, quicker ramp up to production and significant cost savings.

During the standard cell or gate array development stages, our engineering staff becomes your engineering staff and provides step-by-step guidance toward first-time prototype success.

Not so incidentally, we use the Zyp* standard cell design system, which provides the benefits of full custom CMOS technology, including high performance, low power consumption, small size, reliability and low production costs — without long, expensive development cycles.

*Licensing Agreement, ZyMOS Corporation.

THE REMINDER

All through history, some people have made things better than other people. General Instrument Microelectronics is the best choice for all of your Semicustom needs.

THE CHALLENGE

Make us prove it.

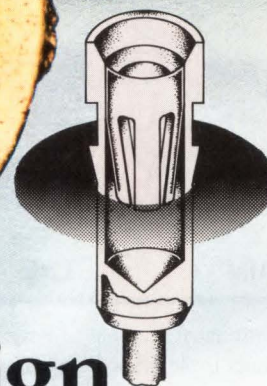
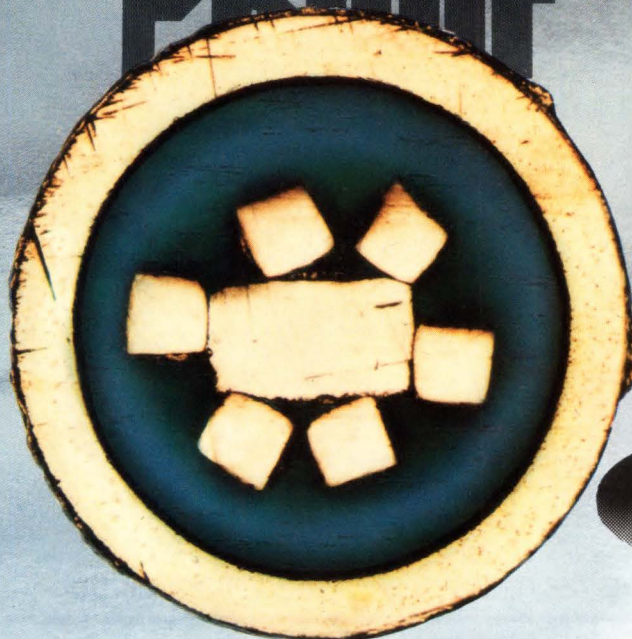


We help you compete.®

**GENERAL
INSTRUMENT**
MICROELECTRONICS

Sales Offices USA: CA, 213-322-7745 or 408-496-0844; GA, 404-476-0274; IL, 312-981-0040; IN, 317-841-9328 or 219-291-0585; MA, 617-938-5890/91; MD, 301-269-6250; MN, 612-894-1840; NC, 919-828-0317; NJ, 201-254-5024; NY, 516-933-3379; TX, 214-934-1654; **EUROPE:** London, Ruislip, (8956), 36141; Milano, (2) 5062648; Muenchen, (89) 956001; Paris, (1) 374-1133; Stockholm, (8) 679925; **ASIA:** Hong Kong, (5) 434360; Osaka, (06) 323-1877; Seoul, (2) 744-8543; Singapore, (65) 235-8030; Taipei, (2) 914-6234; Tokyo, (3) 437-0281

MICRO PHOTO PROOF

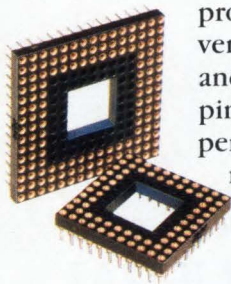


Cross section of new RN 6-finger pin socket. Unretouched microphoto (500X) shows 6 points of IC lead contact.

New 6-finger pin design obsoletes ordinary pin sockets!

2.5 oz. average insertion force!

These new RN PIN GRID ARRAY Sockets provide maximum protection for your expensive high performance pin grid devices. The new 6-finger pin design (instead of the usual 4-fingers) provides insertion force that is a very low average 2.5 oz. per pin and allows easy insertion of high pin count packages. Gas-tight performance is guaranteed. You get maximum reliability, low contact resistance and protection for delicate IC leads. Pin counts range from 44 to over 200.

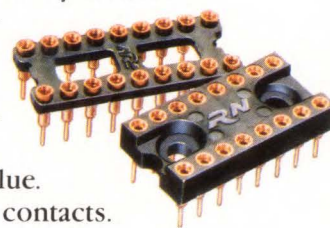


WRITE TODAY for complete specifications and test data on this revolutionary new 6-finger contact design incorporated in both RN Pin Grid Array Sockets and HI-REL DIP Sockets.



50% greater contact redundancy!

These new HI-REL ICA Series DIP Pin Sockets offer the greatest contact reliability available today. The 6-finger design provides a 50% increase in contact redundancy (as compared to the ordinary 4-finger design) and consistent low contact resistance. Temperature/humidity tests of these sockets per MIL-STD-202F, Method 106E, exhibit a standard deviation of contact resistance within 10% of the average value. Available with 6 to 64 contacts.

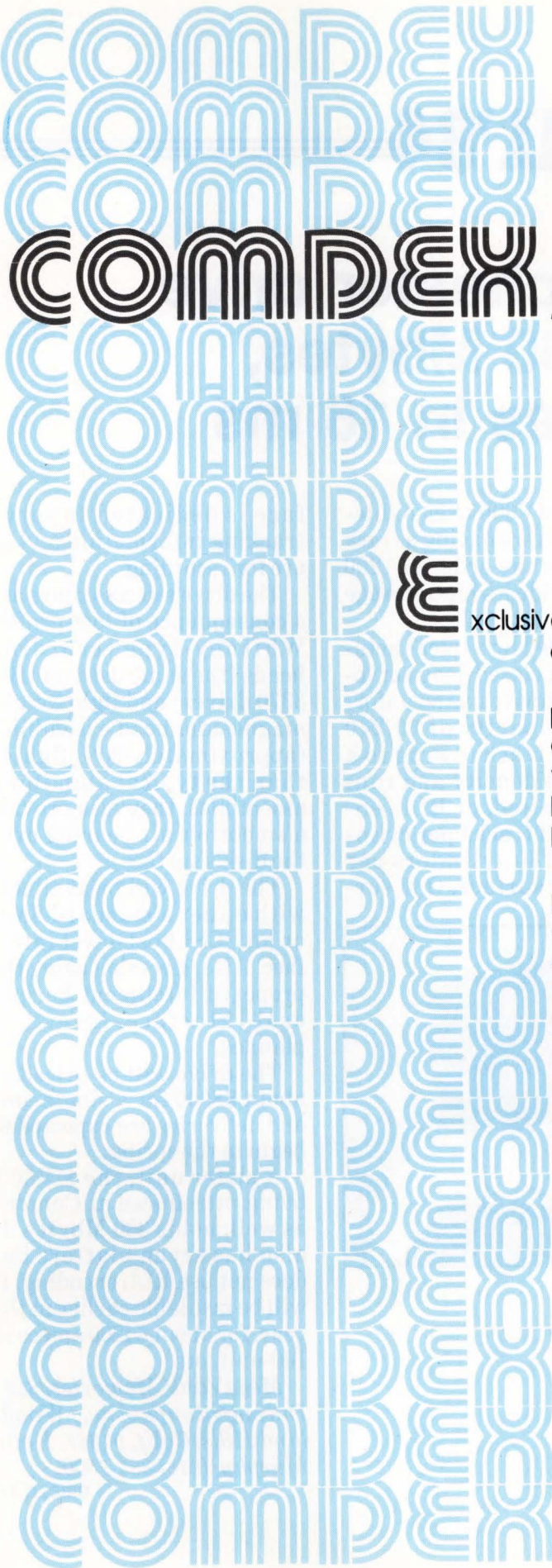


CIRCLE 215

Robinson Nugent



800 East Eighth Street, New Albany, Indiana 47150 • Phone: (812) 945-0211
In Europe: Rue St. Georges 6, CH 2800 Delémont, Switzerland • Phone: (066) 22 98 22



COMDEX / FALL '84



Exclusively a computer retailers' exposition when it began in 1980, Comdex has become perhaps the premier showcase for small computer hardware and software for OEMs. In fact, the annual fall version, being held this year Nov. 14-18 in Las Vegas, has now practically eclipsed other computer shows in the volume of OEM new-product activity.

More than 1300 exhibitors will be at the show, displaying systems, boards, disk drives, terminals, components, operating systems, and application software. The following products are only a small fraction of the items to be unveiled.

8-in. Winchester drive hits 660 Mbytes, accesses in 18 ms

The new record-holder for announced 8-in. Winchester disk drives is a seven-platter unit that stores 660.4 Mbytes—far more than the previous high of 516 Mbytes (on six platters). Furthermore, the high capacity does not come at the price of access time, which is only 18 ms average and 40 ns maximum.

From MegaVault Memo-

Stephan Ohr

ries, the MV600 uses oxide-coated platters having a track density on the order of 1200 tpi to provide its high storage capacity.

Controlled by a linear actuator and a closed-loop servomotor, the drive has an unfformatted capacity of 30,240 bytes per track (owing to a 10,885-bpi density and run-length limited, or RLL, encoding), 13 tracks per cylinder, and 130 cylinders per recording surface. One sur-

face is dedicated to servo tracking information and 13 are for recording.

The drive's access times are a consequence of low-profile Whitney-type recording heads (the same used on IBM 3370 drives) and lightweight magnesium head assemblies (approximately 30% lighter than the typical aluminum assemblies, they also provide a smoother air bearing over the disk's surface).

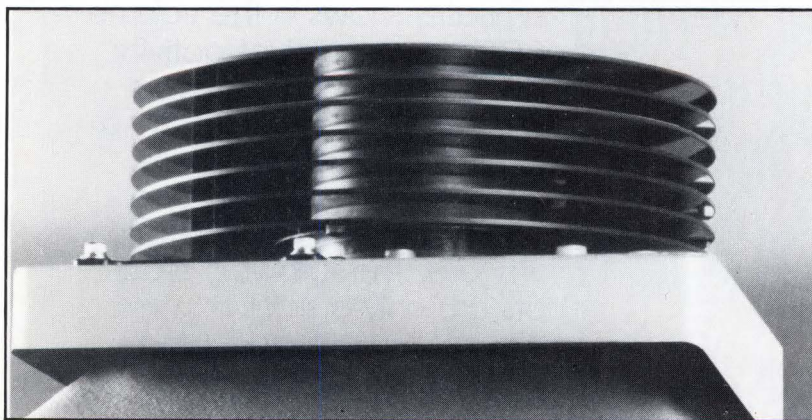
The drive will be available with either a standard SMD or an SCSI host-level interface. Also, a version using the proposed Intelligent Peripheral Interface, level 2, is planned.

The drive will be priced at about \$8000 for a single unit and deliveries are expected to begin in the spring.

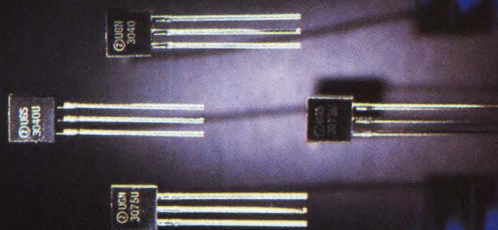
A sister unit, the MV300, being introduced at Comdex as well, holds 330 Mbytes. It also has seven platters but does not use RLL encoding. It will be available earlier in the year, for about \$4200 apiece in 100-unit lots.

MegaVault Memories, 6431 Independence Ave., Woodland Hills, Calif. 91367; Keith Murphy, (818) 884-7300.

CIRCLE 470



CLEAN SWITCHING.



4SS-4131

SPRAGUE MAKES HALL EFFECT SWITCHING EASIER.

Sprague Hall Effect Digital Switches and Latches are magnetically activated for improved switching in many applications, such as: automotive ignition, speedometer pickups, tachometers, gasoline flow meters, brushless DC motors, and computer peripherals. Each Hall Effect IC is complete with a voltage regulator, Hall voltage generator, signal amplifier, Schmitt trigger, and open-collector output on a single silicon chip. Output is clean, fast, and switched with no bounce.

No moving parts . . . no contacts to wear.

For applications assistance, contact Peter Boehm at 603/224-1961, Ext. 275. For technical information, write for Engineering Bulletin 27701 (28 page applications guide), Engineering Bulletin 27607A (UGN/UGS 3040U), and Engineering Bulletin 27608 (UGN/UGS-3075U) to Technical Literature Service, Sprague Electric Company, a Penn Central unit, 347 Marshall St., North Adams, Mass. 01247.

SPRAGUE
THE MARK OF RELIABILITY

CIRCLE 216

SCSI controller cards boost capacity, manage removable disks and tapes

Three mass-storage device controller cards employing SCSI intelligence offer a 50% increase in hard disk storage capacity, soft-sector pulses for new-generation removable hard disks, or control of tape backup devices using the QIC-36 interface. Additions to a line of low-cost boards from Adaptec, the ACB-4070, ACB-4010, and ACB-3530 all provide a Small Computer Systems Interface with their host computer and are capable of offloading data storage man-

Stephan Ohr

agement tasks from the host.

The ACB-4070 is the first 5 $\frac{1}{4}$ -in. hard-disk controller to replace the standard MFM data encoding scheme with an 2,7 run-length-limited (RLL) encoding on an otherwise standard ST506 drive-level interface. Using RLL encoding instead of MFM doubles the storage capacity of the drive and similarly raises the effective data transfer rate from 5 to 7.5 Mbits/s. (The data separator on the disk drive, however, must operate within a 67-ns window, rather than the 100 ns typical of older ST506 drives.)

The ACB-4010 is the first SCSI controller to handle both hard-sectored fixed Winchester disk and hard- and soft-sectored removable hard disks. The heart of the board is a proprietary AIC-100 Winchester controller chip programmed (in ROM) to generate sector pulses for removable-disk drives.

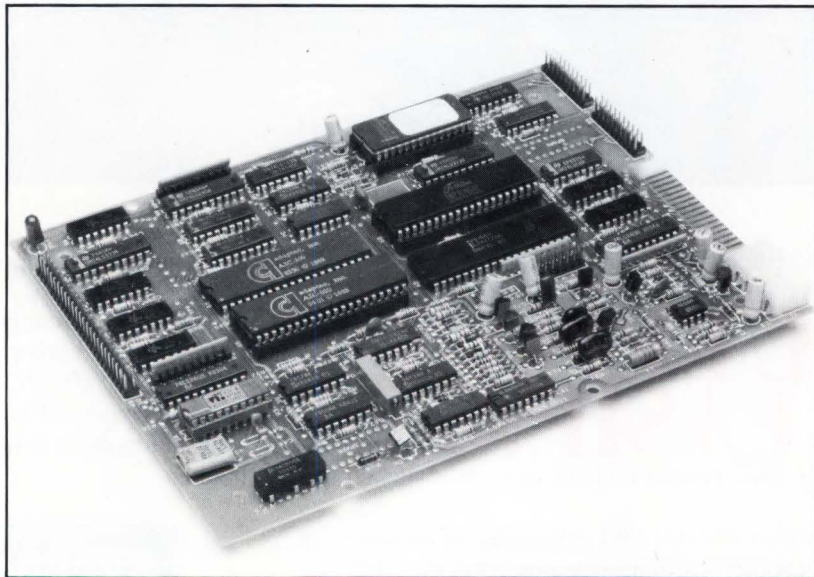
The ACB-3530 tape controller provides backup functions by serving a nonintelligent (i.e., target) role on the SCSI bus. It employs the QIC-36 device-level interface for $\frac{1}{4}$ -in. streaming-tape cartridges. The read/write format of the tape is QIC-24, however, but the controller can also read QIC-11-formatted tapes.

The board includes an 8-kbyte buffer that permits overlapped disk seeks and tape operations and rapid data transfer in the streaming mode (90 ips).

In 100-unit lots, the ACB-4070 is priced at \$280 each, the ACB-4010 at \$255, and the ACB-3530 at \$350. The boards will be available in small quantities in November.

Adaptec Inc., 580 Cottonwood Drive, Milpitas, Calif. 95035; Anne Banta, (408) 946-8600.

CIRCLE 465





The new 2150/2160 VideoBridge® from ESI puts the versatility of 20Hz to 150kHz passive component testing right at your fingertips. One look at the full-information video display and you'll be a believer.

Test at working conditions. Testing at simulated working conditions can eliminate failure on the board. The new VideoBridge lets you program test frequencies from 20Hz to 150kHz, including 100kHz ESR, constant current levels up to 100mA and test voltages up to 1.5VRMS. Interfaces to handlers and computers allow the VideoBridge to be the heart of an automatic test system. For

FROM 20Hz TO 150kHz SEEING IS BELIEVING.

zero defect programs, the VideoBridge's 0.02% basic accuracy means real confidence in your test results.

High performance that's simple to use. Setup is a snap with the new VideoBridge, and test conditions are confirmed with just a glance at the video screen. One simple process calibrates your test fixture for all ranges. Connect a component. The VideoBridge sets itself for the proper function—L, R or C.

Built-in tape drive. Testing many different parts? You can load a compli-

cated setup from tape in seconds, and without error. For detailed yield analysis, load our Statistics Software.

For incoming inspection, engineering, or manufacturing take a good look at the versatile new VideoBridge. Call 800-547-1863 for more information.

Putting Precision To The Test.

CIRCLE 217



Electro Scientific Industries, Inc.
13900 N.W. Science Park, Portland, OR 97229
800-547-1863 (in Oregon call 503-641-4141)

μ C system gives 36 users choice of CPU, OS

A multi-user microcomputer system has enough power to accommodate 36 users. Based on a local-area network architecture, Molecular Computer's Series 36, like its 16-user predecessor, the Series 9, allows each user to choose his own independent application processor and operating system, as well as access shared resources quickly.

The application processor is a complete single-board computer. Each user can choose either an 8-bit Z80A processor with 64 kbytes of RAM or a 16-bit 80186 with 256 kbytes of RAM. The user can also choose CP/M-80, CP/M-86, MP/M, or (in some cases) MS-DOS as the operating system. What's more,



the choices can be selected by commands from any terminal: A built-in processor connects the terminals with selected terminal boards.

The system is held together by the m/Bus Interprocessor Link hardware and the n/Star network operating system. A parallel bus, the m/Bus operates at 400 kbytes/s and negotiates bus contention conflicts with CSMA/CD (carrier-sense multiple access with collision detection). The n/Star operating system includes a multi-user editor and data-base manager.

A basic System 36, which includes a 60-Mbyte 5 $\frac{1}{4}$ -in. Winchester drive and 8- and 5 $\frac{1}{2}$ -in. floppy-disk drives, costs \$21,995. Shipments will start in November.

Molecular Computer, 251 River Oaks Pkwy., San Jose, Calif. 95134; (408) 262-2122.

CIRCLE 468

3 $\frac{1}{2}$ in. floppy-disk drive stores 1 Mbyte

One of the first 3 $\frac{1}{2}$ -in. floppy-disk drives to achieve an unformatted capacity of 1 Mbyte, the H355-10 from Hi-Tech Peripherals does so in large part by recording on both sides of the disk. (Advocates of the 3 $\frac{1}{2}$ -in. floppy-disk standard have always said it could be done, but Hi-Tech is among the first to actually do it.)

The capacity becomes 656 kbytes, divided into 16 sectors

per track and 256 bytes per sector. It is based on a linear density of 8187 bpi and a track density of 135 tpi (80 tracks per surface).

The drive is meant to replace high-density 5 $\frac{1}{4}$ -in. floppies in personal computers and desktop systems. Consequently, the system interface is similar to that for a 5 $\frac{1}{4}$ -in. unit—it uses a 250-kbit/s data transfer rate and MFM encoding.

The drive's rotational

speed is 300 rpm (as opposed to the 600 rpm proposed by Sony and actually used by Hewlett-Packard), and it has a 100-ms average rotational latency.

Production quantities will be available early in 1985, and pricing is \$125 each in 500-piece lots.

Hi-Tech Peripherals Corp., 15192 Triton Lane, Huntington Beach, Calif. 92649; Ethel Myers, (714) 891-0027.

CIRCLE 471

Get your **Multibus/iLBX*** system up to speed with the **MM-7200D**, dual-port memory board.

Take advantage of the speed available in your ISBC286/10* system by using the **MM-7200** Multibus/iLBX memory board from Micro Memory Inc. Access time is 210 nsec for both the Multibus and iLBX ports, and the Multibus/iLBX cycle time is just 325 nsec. These characteristics allow you to realize the full speed potential of Multibus/iLBX. And, the **MM-7200** is compatible with other Multibus/iLBX systems that employ 68000, 80286, 8086 and Z8000 microprocessors.

A broad range of storage capacities are available: 128K, 256K, 512K, 1M, or 2M bytes.

To enhance system performance, there is parity generation and checking. The parity output can be jumpered to any of the bus interrupts on the Multibus

and to parity error (TPAR*) on the iLBX bus. With the Multibus, parity output is stored in a status register that is addressable in the 16-bit I/O page. In addition, an on-board LED indicates parity errors.

For improved multiprocessor system performance, speed can be optimized by using the XACK/ jumper option for Multibus and the ACK* jumper option for iLBX.

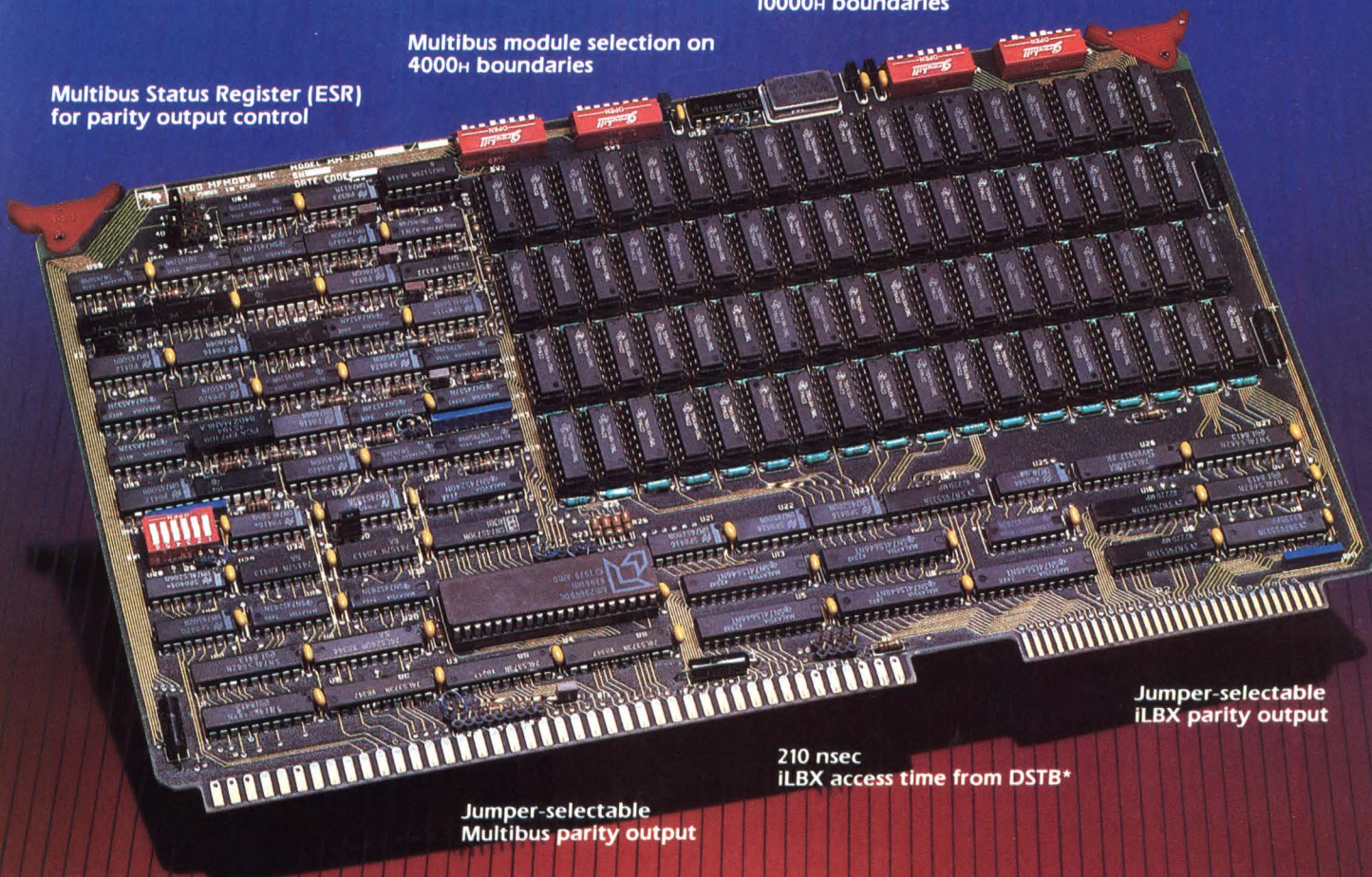
Furthermore, all boards are temperature-cycled and burned-in during memory diagnostics and there is a one-year warranty on parts and labor.

325 nsec
Multibus/iLBX cycle time

iLBX module selection on
10000H boundaries

Multibus module selection on
4000H boundaries

Multibus Status Register (ESR)
for parity output control



Jumper-selectable
iLBX parity output

210 nsec
iLBX access time from DSTB*

Jumper-selectable
Multibus parity output

210 nsec
Multibus access time from MRDC/

* Multibus, iLBX and ISBC286/10 are trademarks of Intel Corporation.

**micro
memory
inc**

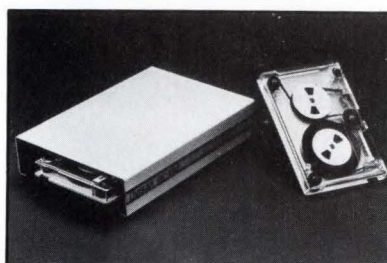
...FIRST IN MICROCOMPUTER MEMORIES

9436 Irondale Avenue • Chatsworth, California 91311 • (818) 998-0070
CIRCLE 218

Tape drive for PCs backs up 45 Mbytes

A stand-alone 1/4-in. cartridge tape drive stores up to 45 Mbytes, one of the highest capacities for personal computers. Called QIC-File by its maker, Sysgen, the tape drive also is one of the first to embody the newly adopted QIC-36 interface.

The QIC-36 interface allows for a 16-bit parallel data transfer between host and tape drive, which facilitates a much faster data transfer and high-speed streaming. With a streaming speed of 90 ips, the



QIC-File copies at some 2.5 Mbytes/min.

The drive, the first version of which provides a host adapter card for the IBM PC bus (8 bits), uses a nine-track serpentine recording format on a DC 600A 1/4-in. tape car-

tridge. The actual drive unit is an Archive Scorpion, and the proprietary controller, which Sysgen builds, includes ROM-based bootstrap utilities for easy software integration with microcomputer operating systems such as MS-DOS and CP/M.

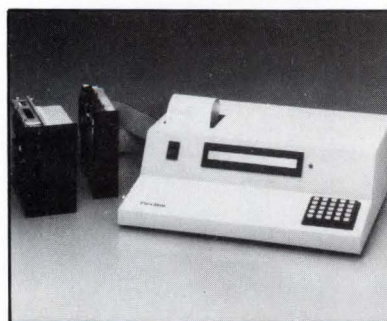
The price of the drive is \$1395 for a single unit. Deliveries of production quantities will start in January.

Sysgen Inc., 47853 Warm Springs Blvd., Fremont, Calif. 94539; Richard Newsome, (415) 490-6770. **CIRCLE 466**

Portable unit diagnoses Winchesters digitally

A completely portable test system will give a complete digital diagnosis for all 5 1/4- and 3 1/2-in. Winchester disk drives using the industry-standard ST506/412 device-level interface. The FS-5000, made by FlexStar, provides all the hardware and software necessary to test two drives at the same time—and still fits into a briefcase-sized package.

The FS tester will do phase-margin (window) testing (i.e., how accurately the disk can read programmed shifts in MFM-encoded data) and scan testing of a phase-margined disk surface to a resolution of 1 ns and an accuracy to within 1 ns. The surface-scan test will provide a defect map of a



disk surface by cylinder, head, byte count, and/or bit length, and is useful in reformatting applications (i.e., reallocating the usable surface of an otherwise defect-ridden disk). The FS-5000 also includes a power supply designed to run an ST-506-type drive.

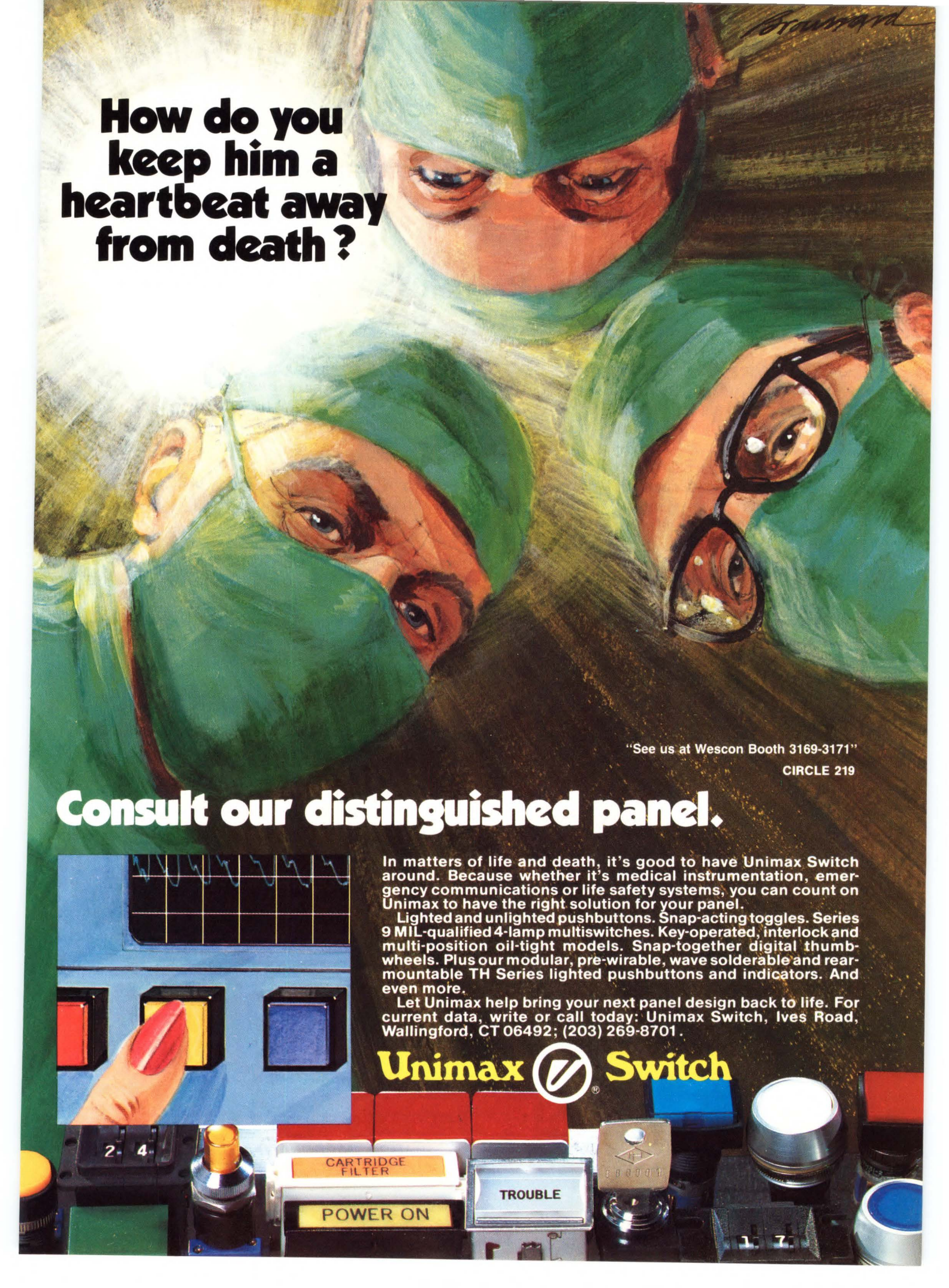
Test variables, like the appropriate phase margins for surface-scan testing, are pro-

grammed by the user, who works through menu-driven software, a built-in 50-character keyboard, and a 40-column LCD display.

Built around a Z80 processor, the tester is entirely self-calibrating and ordinarily requires no adjustment. Test routines can be stored and recalled at a future time, and the test results can be printed out by an integral 40-column printer or uploaded to a larger computer through an RS-232 port.

The unit is priced at under \$5000. Delivery is slated to start in November.

FlexStar, 780 Trimble Road, Suite 204, San Jose, Calif. 95131; George Robinson, (408) 946-1445. **CIRCLE 469**

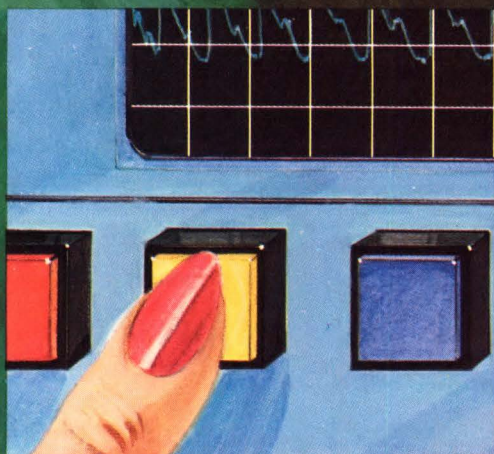


**How do you
keep him a
heartbeat away
from death?**

"See us at Wescon Booth 3169-3171"

CIRCLE 219

Consult our distinguished panel.



In matters of life and death, it's good to have Unimax Switch around. Because whether it's medical instrumentation, emergency communications or life safety systems, you can count on Unimax to have the right solution for your panel.

Lighted and unlighted pushbuttons. Snap-acting toggles. Series 9 MIL-qualified 4-lamp multiswitches. Key-operated, interlock and multi-position oil-tight models. Snap-together digital thumbwheels. Plus our modular, pre-wirable, wave solderable and rear-mountable TH Series lighted pushbuttons and indicators. And even more.

Let Unimax help bring your next panel design back to life. For current data, write or call today: Unimax Switch, Ives Road, Wallingford, CT 06492; (203) 269-8701.

Unimax  **Switch**



8-in. Winchester holds 225 Mbytes

A Winchester fixed-disk drive stores 225 Mbytes in a standard 8-in. package, giving it one of the highest storage capacities that is now available in that size.

The Commanche 8220 from Amcodyne also boasts a fairly quick average access time of 25 ms and a worst-case figure of 46 ms.

Incorporating the SMD interface, the 8220 transfers data at 1.229 Mbytes/s. The drive stores 45 Mbytes of un-



formatted data on each of its five platters and uses 10 mini-slider heads, one per data surface. It devotes one track to servo information, read by a single servo head.

The heads are retractable and are held away from the

surface until the disk reaches 3600 rpm, so that they land on an air bearing, never touching the disk surface.

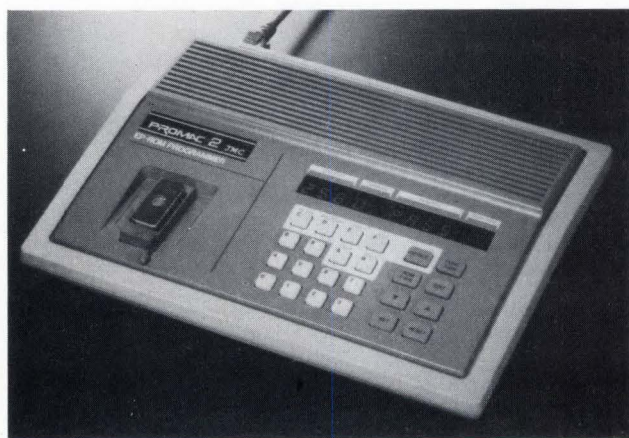
The drive weighs 19 lb. It consumes 180 W during seeks and 9 W during reads and writes.

The unit price is \$3795 in 100-piece lots. Production deliveries will start by the end of the year.

Amcodyne Inc., 1301 South Sunset St., Longmont, Colo. 80501, (303) 772-2601.

CIRCLE 467

PROMACYOUR PROGRAMMER FAMILY



PROMAC 2

EPROM PROGRAMMER for
ENGINEERING and FIELD SERVICE

- Programs all popular 24/28 PIN MOS, CMOS, E² Devices, up to 256K.
- 32 KByte RAM buffer with extensive editing
- RS-232-C interface with selectable formats and baud rates
- Supports fast programming algorithms
- Supports silicon identifiers
- Provides device protection tests (shorts, rev. insertion, cold-socket)
- PROMCOM: optional IBM/PC remote control program
- Field service features: checksum, self diagnostics, Hi/Low verify, carrying case.
- One-year warranty

\$1,195.00

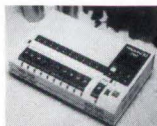
COMPARE . . . THEN BUY PROMAC!

PROMAC 3



Universal Logic Programmer

PROMAC 10



Low Cost Production Programmer

NEW!

am:

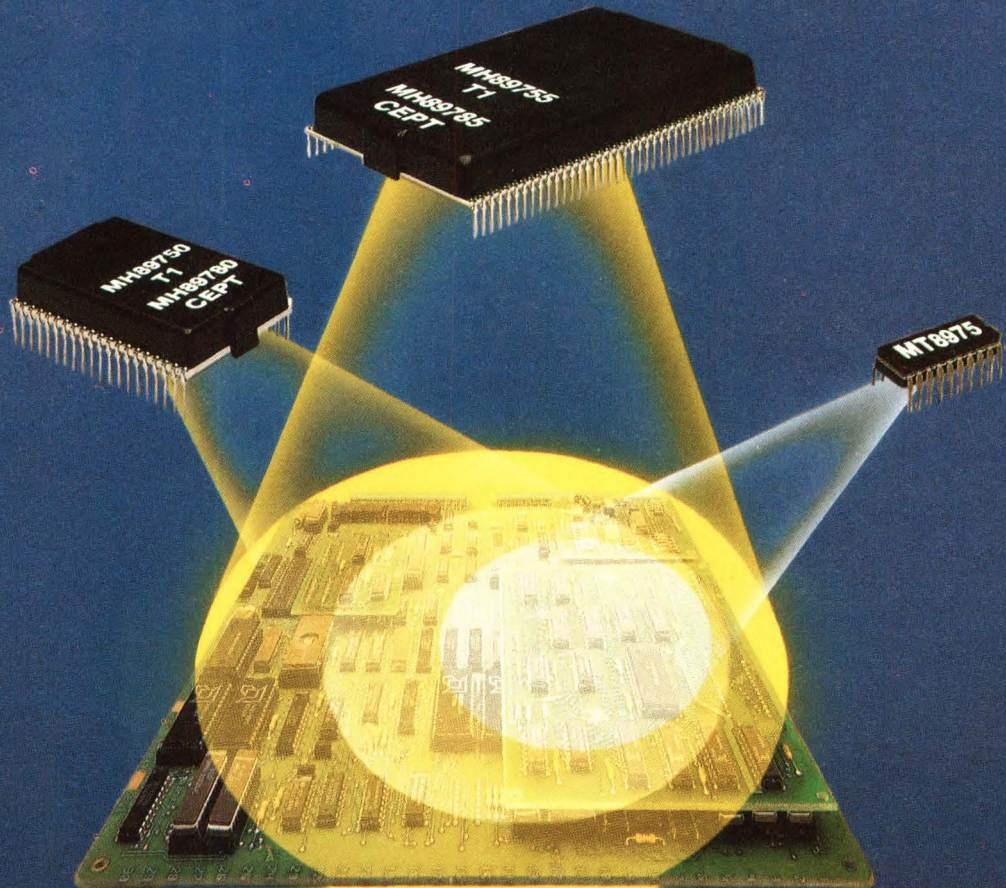
ADAMS ■ MACDONALD INTERNATIONAL, INC.

2999 Monterey/Salinas Highway
Monterey, California 93940

(408) 373-3607
TLX: 882141

Need a T1/CEPT Trunk Solution?

Mitel Components Shed New Light on Digital Trunk Design



MT8975 DS1/T1 DIGITAL TRUNK INTERFACE CIRCUIT
MH89750/755 DS1/T1 DIGITAL TRUNK INTERFACE MODULES
MH89780/785 CEPT DIGITAL TRUNK INTERFACE MODULES

- Complete interface between DS1/T1 or CEPT digital trunks and *ST-BUS*[™] or parallel μ P ports.
- Clock extraction, generation and synchronization.
- B8ZS, Jambit, AMI and HDB3 en/decoding.
- Insertion and detection of A, B, C, D and S bits.
- Line driving, equalization and isolation.

Mitel Semiconductor is now offering a complete line of digital trunk interfaces (DTIs) for DS1/T1 and CEPT applications.

Available in several functional and packaging configurations, the T1 and CEPT line of DTIs are

optimized for integrated digital network products ranging from PBXs and public exchanges to LANs, multiplexers, and workstations.

Are you looking to address the global integrated voice/data market quickly or to improve your existing system design? In either case, this Mitel line will reduce your system cost, size, power consumption, design and manufacturing time. In addition, Mitel application engineering support is available to facilitate fast system design or redesign.

Contact your local Mitel sales office for further information.

The Serial Telecom (ST) Bus is a 2.048 Mbps serial transmission format for frame-formatted PCM-encoded voice or digital data. This *ST-BUS* format is expressed in a family of components, and ensures interconnection compatibility between all devices.

MT894x Timing Circuits
MT895x Data Interfaces

MT896x Voice Codecs
MT897x Digital Line/Trunk Interface Circuits

MH897xx Digital Line/Trunk Interface Modules
MT898x Digital Switches



MITEL[®] SEMICONDUCTOR

CIRCLE 221

United States: 2321 Morena Blvd., Suite M, San Diego, California, U.S.A. 92110
Telephone: (619) 276-3421, TWX: 910-335-1242

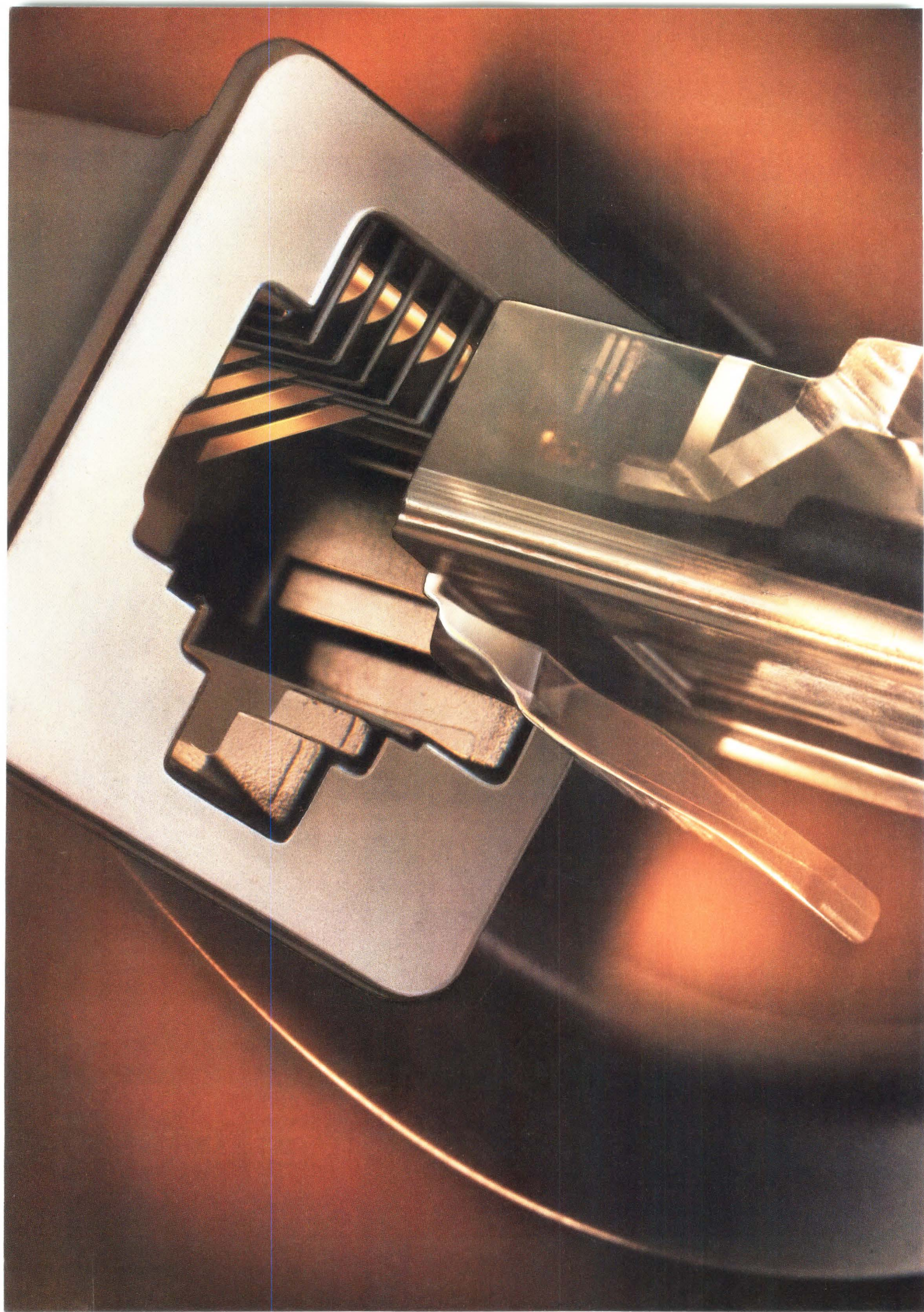
Canada: P.O. Box 13320, 360 Legget Drive, Kanata, Ontario, Canada K2K 1X5
Telephone: (613) 592-5630, Telex: 053-3221
TWX: 610-562-1678

Europe: Severnbridge Estate, Portskewett, Newport, Gwent, Wales NP6 4YR
Telephone: 291-423355, Telex: 497-360

Bredgade 65A, 2nd Floor, 1260 Copenhagen K, Denmark
Telephone: (01) 134712, Telex: 19502

Via C-Gluck, 59, 20131, Milano, Italy
Telephone: 02-6072603

CDW Building, 22nd Fl., 388 Castle Peak Rd., Tsuen Wan, Hong Kong
Telephone: 0-463641 TLX: 34235 Mitel HX



Modular plugs and jacks from AMP.

The new interface story with a happy, low-cost ending.

Now, here's everything you're looking for in an interconnect system bound for the everyday world. The popularity and wide acceptance of modular design. The low applied cost and tooling support you need to make the most of it.

Check our variety and value-added features: pre-loaded plugs that mass terminate tinsel or stranded wire, with double strain relief; pcb jacks in top and side-entry versions; Accu-Plate selective gold contacts for cost-effective reliability, tin-plated legs for solderability.

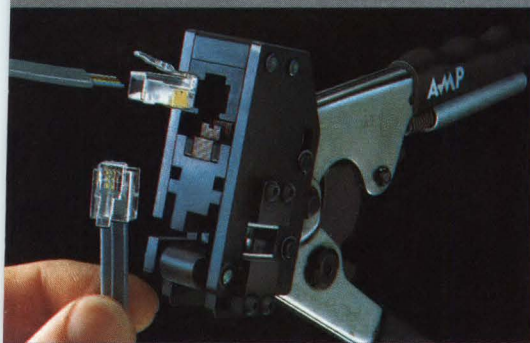
And our quality hand tool is the best of its kind anywhere. Cuts and strips cable jacketing. Mass terminates conductors in one operation.

AMP Modular Interconnect Systems answer a wide range of interface needs. Data communications. Home computers and electronic games. Telecommunications. Any I/O application, in fact, where you need a durable, versatile, inexpensive interconnect familiar to everyone.

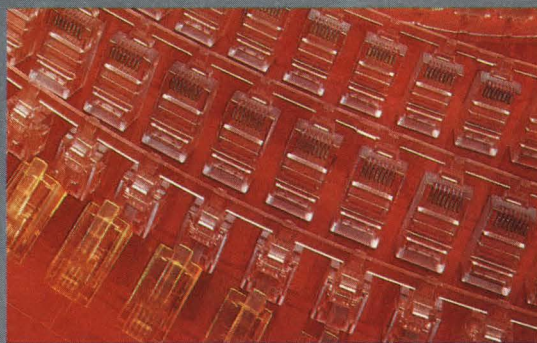
And supported by a familiar philosophy: increased productivity, from AMP.

**For more information, contact the
Modular Interconnection Desk at (717) 780-4400.
AMP Incorporated, Harrisburg, PA 17105.**

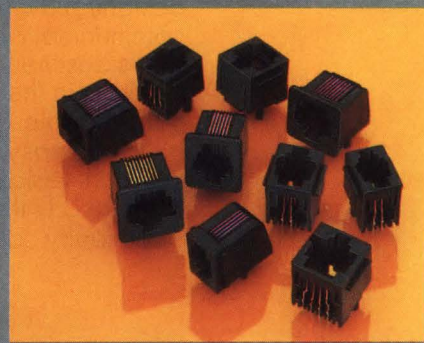
AMP means productivity.



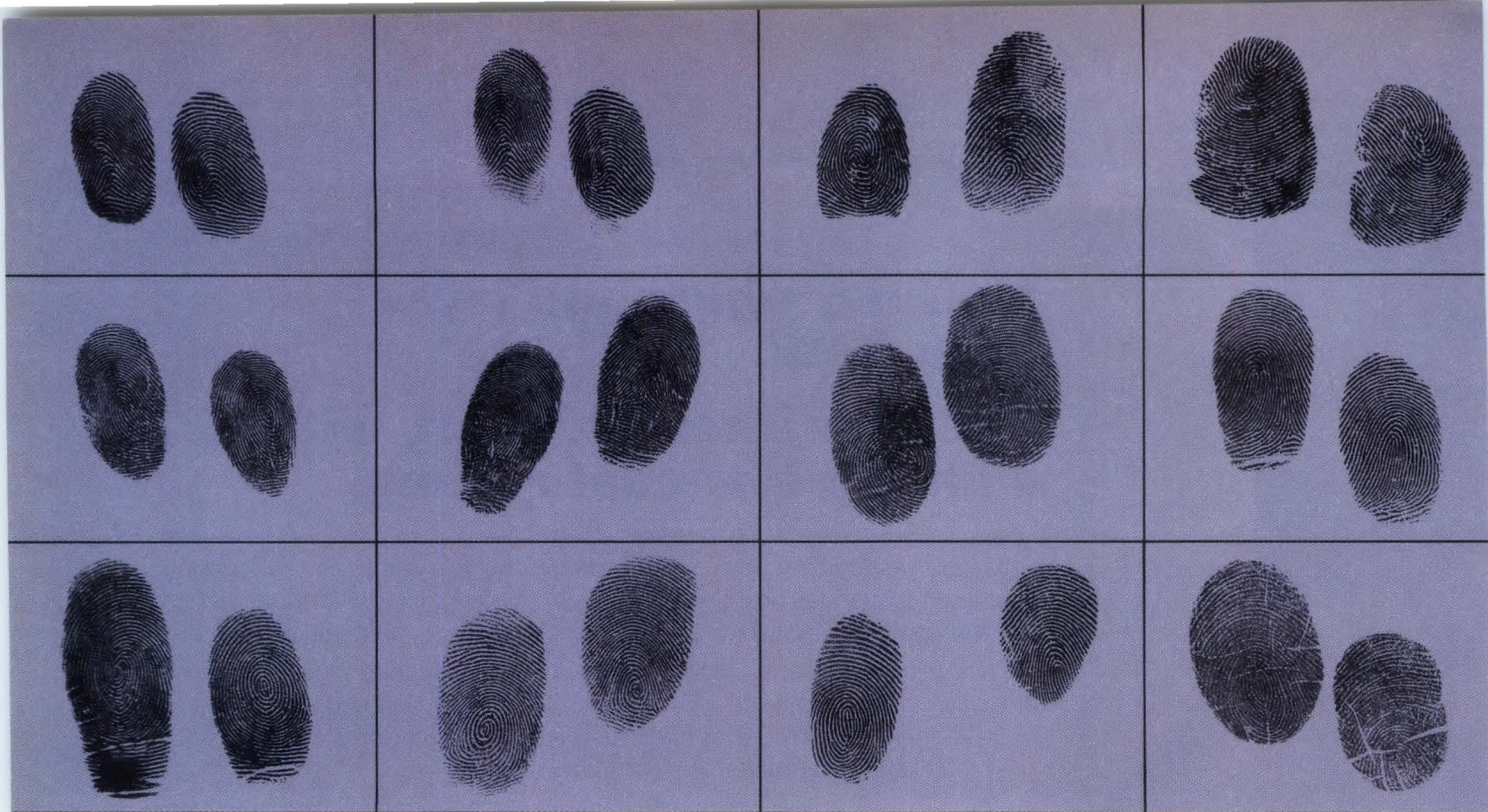
The AMP Modular Plug hand tool cuts, strips cable jacket, and terminates loose piece plugs. Accepts 2, 4, 6 or 8-position connectors with quick-change dies.



AMP modular plugs in strip form for termination with AMP high-speed application tooling.



AMP modular jacks feature high reliability. U.L. listed in top-entry and flanged or flangeless side-entry versions.



BECAUSE NO TWO ENGINEERS ARE EXACTLY ALIKE,

As you well know, everything electronic is getting smaller. And that's causing some gigantic changes in the PC boards and front panels you're designing today. They're getting smaller, more complicated and more difficult to service.

Fortunately, a technology has emerged that can help throw some light on the subject: optoelectronics. And more and more, the ability to use this technology is becoming the mark of a good design engineer.

THE ABCs OF DESIGNING WITH LEDs.

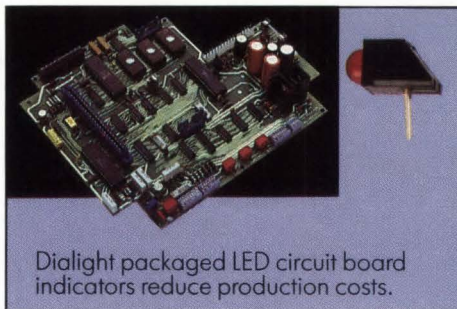
Suppose you want to backlight a front panel from an internal PC board.

You could use value-added Dialight LEDs. They plug right into the board. And since we offer packages in many different heights, they'll hold the light steady at exactly the right distance from the panel.

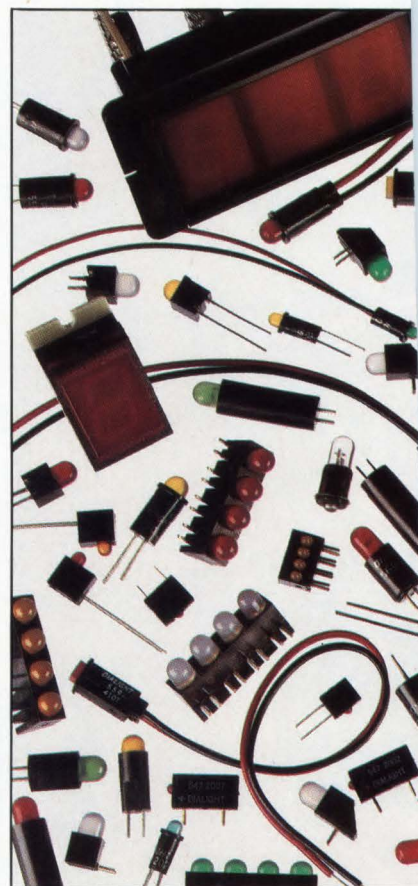
Or what if you're designing a circuit board for communications equipment that's destined to be serviced in the field? To make troubleshooting that board as easy as possible, you can design in a Dialight LED that will point out a faulty component.



Our new Super Brights stand out clearly, even in a computer room.

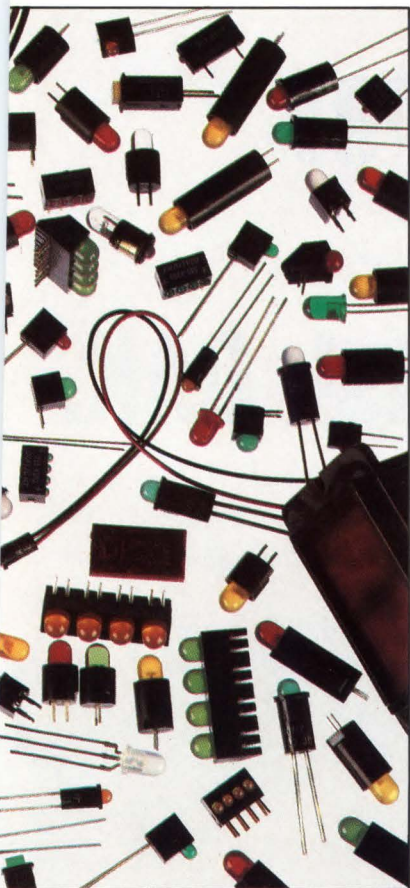


Dialight packaged LED circuit board indicators reduce production costs.





DIALIGHT OFFERS THE LARGEST OPTOELECTRONICS VARIETY.



WE DELIVERED THE FIRST LED CIRCUIT BOARD INDICATORS.

By packaging LEDs, Dialight makes them easier to insert. With no need to bend, trim, and possibly break, delicate leads.

In their mountings, Dialight LEDs look more reliable. And they are. We test every single LED before we ship it.

Of course, you could buy individual LEDs for less. And have somebody bend and trim and insert them by hand. But think what all that hand labor costs. Not to mention the cost of a service call if your light fails in the field.

That's what made our value-added LED such a good idea when we came up with it almost 15 years ago.

And we're still lighting the way. Take our new Super Brights.

They're 4 times brighter than ordinary LEDs.

So they're easier to see. Even in the high ambient light of a computer room. And if you're short on power, they operate on one-fourth the current.

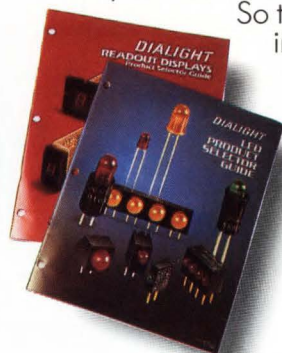
There are a lot more ways to use our optoelectronics in our catalogs. Call 718-497-7600 or write Dialight Corporation, 203 Harrison Place, Brooklyn, NY 11237-1587 and we'll send you copies.

Keep them handy. They'll put hundreds of great little ideas at your fingertips.

A North American Philips Company



We package complete readout assemblies for instant panel mounting.



DIALIGHT OPTOELECTRONICS

Products of your imagination.

"See Us At Wescon, Booth Numbers 3467-71"

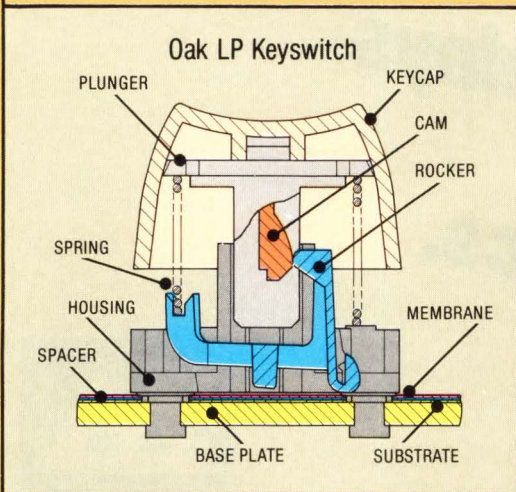
**For the highest quality,
most cost-effective
low-profile keyboards
ask the leader
in full travel
membrane technology.**

Ask OAK.

Tactile or Linear Feel available.



**For engineering excellence . . .
ask OAK**



Introducing the low-profile, DIN compatible keyboard with the features you've been searching for — **Oak's Low-Profile FTM® Keyboard.** Designed especially for high speed data entry systems, where long life and operator comfort are paramount, Oak low-profile FTM keyboards feature a patented keyswitch design. Now, finally, you can specify the "feel" your customers want . . . from standard linear to fall-through tactile.

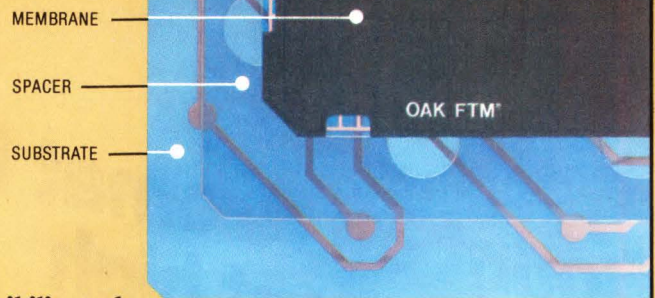


For design flexibility and savings . . . ask OAK

Simple design, coupled with advanced manufacturing, spells maximum design flexibility and savings for you. Oak keycaps are made of durable, lightweight, non-glare polyester and feature a comfortable cylindrical industry standard design. Sublimation printing provides for a wide variety of printing options — quadrant printing, multi-colors, front legending, and custom legends — order whatever you need. And, there are a host of available options to fill most any special design requirement — LED indicators, EMI/RFI/ESD shielding, standard or custom encoding electronics, variable operating forces and more!

For proven technological leadership . . . ask OAK

Oak is the recognized leader in full travel membrane technology, a technology that provides proven performance features, benefits and cost savings not available with other keyboard designs • high reliability • long life of 50 million cycles • elimination of double-sided, plated-through hole printed circuit boards



• environmental protection by design • light weight . . . just a few of the many features designed to help enhance the performance of your product.

For commitment to quality, service and value . . . ask OAK

Oak remains dedicated to staying in the forefront of keyboard technology. To providing a superior quality product, in the quantities you need, on time, at the right price. **To see how the new Low-Profile FTM Keyboard can go to work for you . . . ask OAK.**



OAK Switch Systems Inc.

P.O. Box 517 • Crystal Lake, Illinois 60014
Phone 815/459-5000 • TWX 910-634-3353
TELEX 72-2447

CIRCLE 222



Count on Aromat RF Relays for excellent high frequency characteristics.

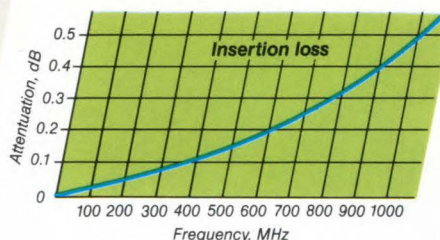
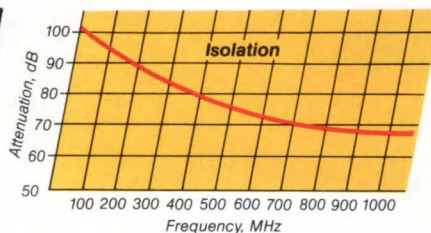
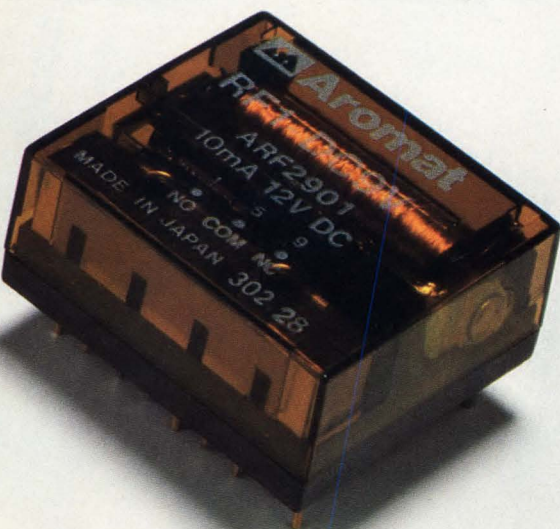
For use in video discs, VCR, CATV, TV games, facsimiles, transceivers and instrumentation, RF relays by Aromat can provide decided advantages over electronic switching circuitry.

These miniaturized, high-frequency, high-speed flat relays are available in 1 form C contact arrangement and offer such important design features as:

- Isolation 65 dB min. at 900 MHz, insertion loss only 1.5 dB max. at 900 MHz. With better than 60 dB isolation, these relays fulfill the FCC high frequency standard.
- High reliability and long life are assured by more than 5×10^6 mechanical operations, more than 10^5 electrical.
- High operating speeds extend the versatility. Operate speed is only 10 msec. maximum, release time is 5 msec. max.
- Flux-resistant molded construction and DIL terminal arrangement, 2.54 mm, .1 inch pitch. Amber sealed types are available.

Aromat RF relays fit right in with your manufacturing processes. They can be wave soldered, hand soldered, or wire wrapped and lend themselves well to automated techniques.

See for yourself.



Relays and Switches for Advanced Technology

Northeast Sales Offices

250 Sheffield St.,
Mountainside, NJ 07092
Tel: (201) 232-4260
TWX: 710-997-9536

Southeast Sales Offices

2480 Sand Lake Rd.,
Orlando, FL 32809
Tel: (305) 855-1075
TWX: 810-850-0256

North Central Sales Offices

311 Lively Blvd.,
Elk Grove Village, IL 60007
Tel: (312) 593-8535
TWX: 910-222-1423

South Central Sales Offices

850 East Arapaho Road,
Suite 210, Richardson, TX 75081
Tel: (214) 235-0415

Northwest Sales Offices

10400 North Tantau Ave.,
Cupertino, CA 95014
Tel: (408) 446-5000
TWX: 910-338-0534

Southwest Sales Offices

11542 Knott Street,
Suite 2, Garden Grove, CA 92641
Tel: (714) 895-7707

For further details on the relays of your choice, write on your letterhead to the Aromat address nearest you.

CIRCLE 228

Single chip develops all the trig functions from sine to arctangent

The system designer has at present several techniques available to produce trigonometric functions, and all have their problems. They are inaccurate, complex, or slow, or some combination of those—including all three. The AD639 from Analog Devices offers a clear way out. This small chip can replace a handful of ROM-based digital circuits or wave-shaping analog circuits, and it is less expensive than all but the cheapest approach using diodes.

What is even more important, just one device creates all the basic trig functions, from sine, cosine, and tangent and their inverses to cotangent, secant, and cosecant. But there is still more: the device also can develop the versine, haversine, and exsecant. To obtain the different functions, the user merely interconnects the chip in different ways.

The basic function produced by the 639 is the ratio of two sine waves. A pair of unique transistor-resistor circuits synthesizes the sines to a conformity of 0.08% and a distortion figure of -74 dB.

Frank Goodenough

That is only possible, though, if the chip is driven by an ultralinear triangular wave, which is not an easy task at 1.2 MHz, the chip's small-signal bandwidth. The rest of the functions are developed from two sine waves and a reference to provide scaling to 90° .

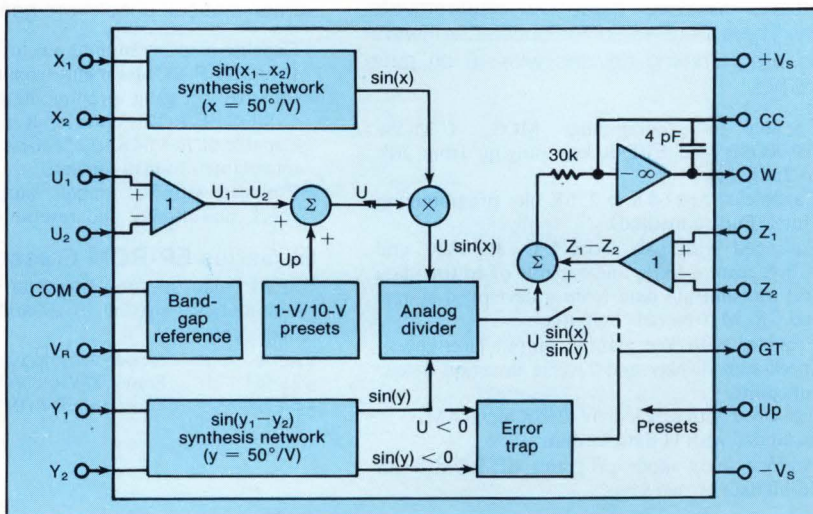
The angular range for sines and cosines is -360° to $+360^\circ$, and for tangents -45° to $+45^\circ$. Peak errors are typically less than 2% of full scale for sine waves and 2.5% for tangent. In addition, the chip has an error trap that

gates open the output and raises a digital flag when the inputs are invalid or out of range (see the figure).

The device operates from ± 5 - to ± 15 -V supplies from -25° to $+85^\circ\text{C}$ and comes in a 16-pin DIP. The unit price in quantities of 100 pieces is \$12 for the AD grade (maximum gain error of 0.5%, voltage offset of 10 mV) and \$19 for the BD (0.25%, 5 mV).

Analog Devices Inc., PO Box 280, Norwood, Mass. 02062; Steve Miller, (617) 935-5565.

CIRCLE 302



A single chip, the AD639, produces all the basic trig functions and more—cotangent, secant, cosecant, versine, haversine, and exsecant. Its error trap raises a digital flag if the inputs are involved or out of range.

Simple one-touch operations and on-line system.

MODEL 1867 Gang EP-ROM Programmer

MODEL 1866 Compact EP-ROM Programmer

< Model 1866 > corresponds to 256 K CP/M and can be operated easily.

Minato's Model 1866 EP-ROM programmer demonstrates excellent performance and ease of use in a compact design that lets you program MOSs, C-MOSs, EP-ROMs and EEPROMs at high speed one-touch operation. Functions of on-line programming devices from a development system and the CP/M personal computer meet your requirements fully. There is no need for optional software and programming devices with 16 bit data by 8 bits.

- Capable of programming MOS, C-MOS, EP-ROMs and EEPROMs ranging from 16k to 256K-bits.
- Capable of fast 64 K to 256K-bits programming (Intel/Fujitsu method).
- Equipped with two serial I/O, RS-232C and 20mA current loop, and capable of editing data and transmitting data from a developed system and CP/M personal computer.
- Provided with Vcc margin, output level check, check sum display and reverse insertion detect functions.
- Equipped with a 32K-byte (256K bit) RAM.
- Equipped with 11 data formats.
- Address select mode programs EP-ROMs with 16-bit data by two 8 bits.

< Model 1867 > has the capability to gang-program eight 256 K devices.

Minato's Model 1867 Gang EP-ROM Programmer is equally compact and equally impressive in capability. Dedicated to copying, it allows simultaneous programming of eight MOS and C-MOS EP-ROMs at ultra high speed. And, just like the Model 1866, check functions including preprogram, reverse insertion and self checks are generous.

- Capable of programming up to eight MOS and C-MOS EP-ROMs ranging from 16 K to 256 K-bits.
- Capable of gang programming 8 MOS and C-MOS EP-ROMs (data input: master ROM).
- Capable of fast 64 K to 256 K-bit gang programming (Intel/Fujitsu method)
- Provided with Vcc margin, output level check, check sum display and reverse insertion detect

EL Series EP-ROM Eraser

You can also use erasers which are capable of simultaneously erasing 10, 27 and 350 EP-ROMs, respectively.

- EL-10Erases 10 EP-ROMs simultaneously.
- EL-187Erases 27 EP-ROMs simultaneously.
- EL-300Erases 350 EP-ROMs simultaneously.

For further information, Please contact

- **AUSTRALIA**
AMPEC ELECTRONICS PTY. LTD.
Phone: (02) 818 1166
- **AUSTRIA** (Wien)
DEG-MESSTECHNIK Phone: 0222/83 53 80
- **BELGIUM**
MCR ELECTRONICS MARKETING
Phone: (02) 384.80.62
- **BRAZIL** (São Paulo)
FILCRES INSTRUMENTOS
Phone: 531-8822—ramais 264 a 271
- **CANADA**
ATELCO INC. Phone: 416-497-2208
- **FINLAND** (Helsinki)
PROFELEC OY Phone: (90) 5664-477
- **FRANCE** (Annecy)
PERIFEEC Phone: (50) 67.54.01
- **HONG KONG**
SCHMIDT & CO. (H.K.) LTD. Phone: 5-455644
- **ISRAEL** (Tel-Aviv)
MLRN ELECTRONICS LTD.
Phone: (03) 796927, 708174-5
- **ITALY** (Milano)
DE LORENZO INSTRUMENTS
Phone: (02) 8242769-8242747
- **KOREA** (Seoul)
TONG YANG COMMERCIAL COMPANY
Phone: 782-7283, 9590
- **MALAYSIA** (Kuala Lumpur)
NIE ELECTRONIC (M) SDN. BHD.
Phone: 3-24341
- **NETHERLAND** (Haag)
KONING EN HARTMAN
ELEKTROTECHNIEK B.V. Phone: 070-210101
- **NEW ZEALAND**
E C GOUGH LTD. Phone: (03) 798-740
- **PAKISTAN** (Karachi)
ASSOCIATED INSTRUMENT
DISTRIBUTORS LIMITED Phone: 79361
- **SINGAPORE**
LIMCO MFG. PTE. LTD.
Phone: 449331 (3 lines)
- **SOUTH AFRICA**
PROTRONIX (PTY) LTD. Phone: 786-1043
- **SPAIN** (Madrid)
ATAIO INGENIEROS S.A.
Phone: 733 05 62—733 37 00
- **SWEDEN** (Stockholm)
TELEINSTRUMENT AB Phone: 08-380370
- **SWITZERLAND** (Zurich)
PRECITEK ELECTRONIC AG
Phone: 01-8442950
- **TAIWAN** (Taipei)
BURGEON INSTRUMENT CO., LTD.
Phone: (02) 7133545, 7137966
- **UNITED KINGDOM**
WESSEX ELECTRONICS LTD.
Phone: (0272) 571404
- **U.S.A.**
OKURA & CO. (AMERICA), INC.
Phone: (408) 279-2840
- **WEST GERMANY** (München)
MACROTRON GMBH Phone: (089) 420 80

* CP/M is a registered trade mark of Digital Research, Inc.



MINATO ELECTRONICS INC.

4105, Minami Yamada-cho, Kohoku-ku,
Yokohama, 223, Japan Phone: 045-591-5611
Cable: MINATOELEC YOKOHAMA
Telex: 3822-244 MINATO J
Fax: 045-591-5618

NEW PRODUCTS

ANALOG

Matched dual op amps offer many benefits

The OP227 and OP237 matched dual op amps afford many advantages, such as their low-cost plastic packaging. Both circuits combine the dc specifications, low noise, and high gain of the single OP27/OP37 circuits with the added benefit of guaranteed matched specifications.

Individual amplifier specifications include a maximum input offset voltage of $80 \mu\text{V}$ and a maximum drift of $1 \mu\text{V}/^\circ\text{C}$. At 0.1 to 10 Hz, the peak-to-peak noise of the OP227/237 is 200 nV. The devices also offer a minimum gain of 1 million when driving a 600- Ω load.

Matched input offset voltage between the two amplifiers is $80 \mu\text{V}$ maximum. The CMRR match is 100 dB minimum, gain match is 6%, and offset current match between like inputs of each amplifier is 60 nA maximum.

Linear Technology Corp., 1630 McCarthy Blvd., Milpitas, Calif. 95035; (408) 942-0810. From \$3.95 (100 units); stock to four weeks.

CIRCLE 313

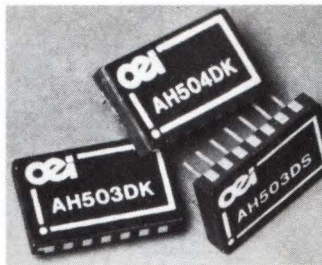
Quad op amp rivals competition

Housed in a 14-pin DIP, the HLT1014 quad op amp is plug-compatible with industry-standard quad op amps while offering superior performance in both single 5-V and $\pm 15\text{-V}$ applications. Like other quad op amps, the

Analog Solutions

Losing your peak?

AH503/AH504: 200nsec max acquisition time peak sense and hold



- ▶ Acquire +10V peak in 200nsec
- ▶ Capture 30mV to 10V peaks
- ▶ Reduced size 5030A
- ▶ 500nsec max gate and reset times
- ▶ \$88.10 in 100's (AH503DK)



P.O. Box 11140, Tucson, Arizona 85734
Phone 602-624-8358, Telex 910-952-1283

See us at Wescon (Booth 2246) and Electronica (Booth 21-B41)

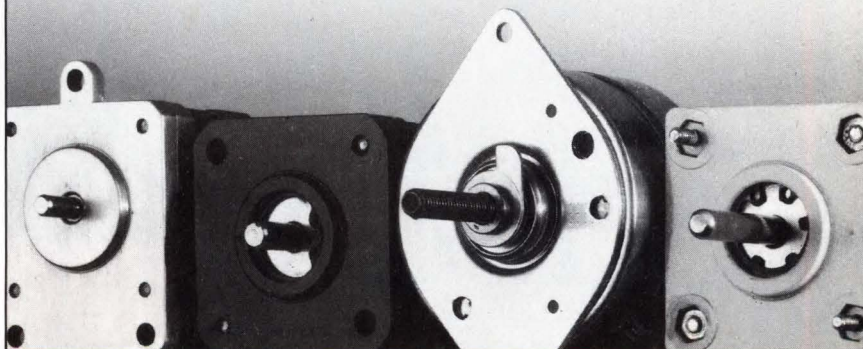
CIRCLE 229

Precision Stepping Motors

Two-Phase Permanent Magnet Stepping Motors Berger Lahr is a leading manufacturer of standard, half stepable, and custom two-phase stepping motors. Our motors have a reputation for high quality, providing superior step angle accuracy and repeatability even in reversible applications while developing high torque.

For applications requiring more power and/or finer step angles, Berger Lahr pioneered five-phase stepping motors. These motors characteristically have smooth dynamic operation with reduced resonance compared to two-phase motors.

For more information on any of our precision stepping motor products, please contact our Sales Department.



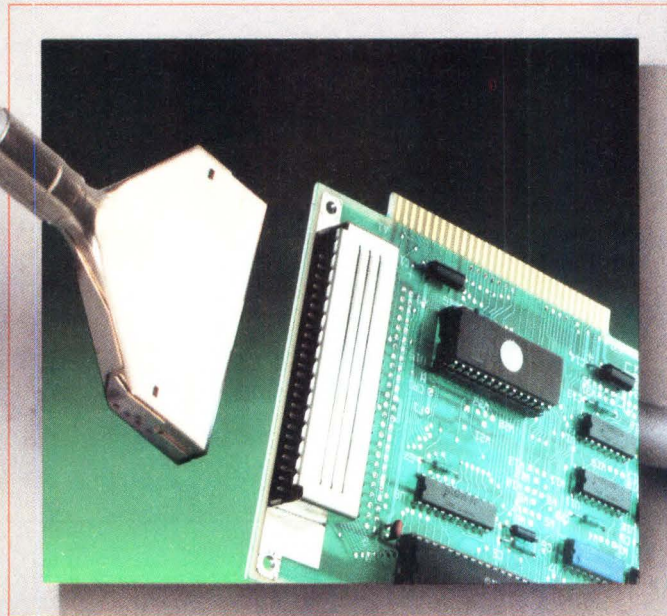
BERGER LAHR
BERGER LAHR CORPORATION

Fitzgerald Drive, Jaffrey, NH 03452
TEL: (603) 532-7701
TELEX: 92-8445 BELACO JAFF

CIRCLE 231

SCSI.

Four letters that let you hook any host...



to any peripheral.

Presenting SCSI. Small Computer Systems Interface. An interface standard that lets you connect small computers with virtually any peripheral device — even those still on the drawing board. Without overhauling your hardware and software. So the best can go with the best, period — not the best of what's compatible.

SCSI works by masking the internal structure of the peripherals from the host. It uses an eight-port bus which can accommodate either single- or multiple-host systems. Its impressive transfer rate of 1.5 Mbytes per second allows direct copying between devices, too. Freeing the host for more important work. And giving it lots of power for lots of I/O activity.

In developing SCSI as a truly versatile standard interface, the American National Standards Institute (ANSI) enlisted some of the best minds in the industry — including more than a few from NCR-Wichita.

NCR is the undisputed leader, too, in designing and manufacturing SCSI components. We offer a complete line, from host adapters for Multibus and

IBM PC architecture to ST-506 and SMDO disk controllers to PERTEC and QIC-02 tape controllers. We've also made numerous advancements in reducing the size of the components — and in reducing their price.

And this same quality of expertise in applications engineering is available to our OEM customers, as well.

SCSI is changing the face of system integration. And NCR has been there all the way. With capacity and technology second to none... and a century of quality behind us.

If you want to know more about what SCSI can do for you, call NCR at 1-800-325-SCSI.

SCSI products from...



Engineering & Manufacturing / Wichita, KS 67226

NEW PRODUCTS

ANALOG

LT1014 also conserves pc board real estate.

Key specifications of the LT1014 include a maximum offset voltage of $180 \mu\text{V}$ and a maximum drift of $2 \mu\text{V}/^\circ\text{C}$. It also has a low 0.8-nA maximum offset current. The LT1014 delivers more than 20 mA of load current with no crossover distortion, while dissipating less than $500 \mu\text{A}$ per amplifier.

Linear Technology Corp., 1630 McCarthy Blvd., Milpitas, Calif. 95035; (408) 942-0810. \$5.35 (LT1014CN, 100 units).

CIRCLE 314

Instrument amp simplifies DAC design

Amonolithic instrumentation amplifier, designated Tarex, reduces the front-end component count in the design of a ratiometric a-d converter. The 16-pin CMOS LSI package is especially suited for use with devices whose output is typically a low-level voltage signal from dc to 10 Hz .

The Tarex chip incorporates a true differential input amplifier, analog and digital power-supply splitters, a clock generator, and tracking gain resistor networks. Despite a substantial closed-loop gain (typically 111), the part has $\pm 0.005\%$ non-linearity and a gain stability to within $\pm 0.001\%/^\circ\text{C}$ over the range of -15° to $+45^\circ\text{C}$.

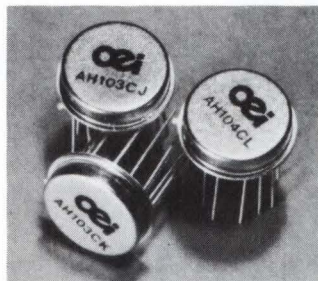
Tedea, 7800 Deering Ave., Canoga Park, Calif. 91304; (818) 884-8818. Less than \$20 (OEM quantities).

CIRCLE 315

Analog Solutions

Life too unsettled?

AH103/AH104:
160nsec to 0.1% FET op amps



- ▶ 160nsec max to 0.1% (AH104)
- ▶ $280\text{V}/\mu\text{sec}$ min (AH104)
- ▶ Internally compensated for unity gain (AH103)
- ▶ 1mV max VOS, $5\mu\text{V}/^\circ\text{C}$ max drift (CL grades)
- ▶ 30ma min out at $\pm 10\text{V}$
- ▶ \$38.60 in 100's



P.O. Box 11140, Tucson, Arizona 85734
Phone 602-624-8358, Telex 910-952-1283

See us at Wescon (Booth 2246) and Electronica (Booth 21-B41)

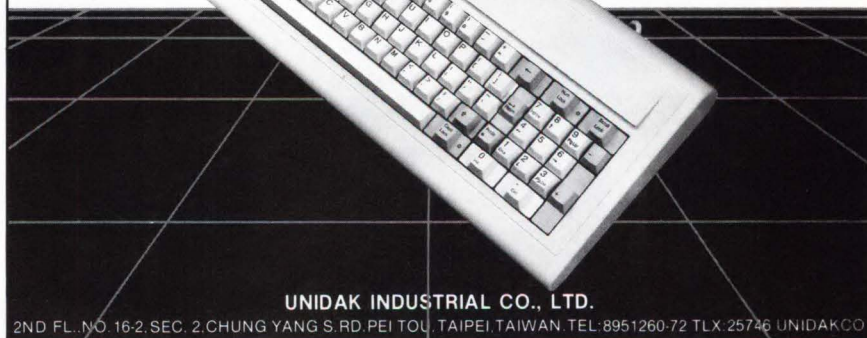
CIRCLE 233



A POWERFUL OEM SUPPLIER

A NUMBER OF OEM'S ALREADY KNOW UNIDAK INDUSTRIAL COMPANY, LTD. HAS THE EQUIPMENT AND EXPERIENCE TO MAKE THE FINEST OF KEYBOARDS AND KEYBOARD COMPONENTS. OUR CUSTOM DESIGN AND TOOLING CAPABILITIES HAVE PROVIDED THOSE CUSTOMERS WITH THE COST ADVANTAGE THEY NEEDED IN A COMPETITIVE MARKET. OUR EIGHT PRODUCTION LINES AND OUR HIGHLY AUTOMATED MACHINES TURN OUT 50,000 KEYBOARDS A MONTH. YOU CAN ORDER AS MANY AS YOU NEED TO CUSTOM DESIGNS. UNIDAK IS THE

POWERFUL OEM SUPPLIER, LOOKING FOR MORE OEMS AND AGENTS TO JOIN US IN PROFITABLE COOPERATING. WE HAVE ALL THE GEAR WE NEED IN HOUSE. IF YOU DEAL WITH US, YOU'LL HAVE ALL THE PROFITS YOU NEED.



UNIDAK INDUSTRIAL CO., LTD.

2ND FL., NO. 16-2, SEC. 2, CHUNG YANG S. RD. PEI TOU, TAIPEI, TAIWAN. TEL: 8951260-72 TLX: 25746 UNIDAKCO

CIRCLE 234

Introducing three new 2465 Special Editions.



Now Tek tops the scope that topped them all!

These specially configured, specially priced measurement packages based on the 300 MHz 2465 deliver capabilities well beyond what you're used to now. Quicker measurements. More precision. More value. They bring unprecedented manual/programmable efficiencies to a spectrum of measurements in manufacturing, design or service applications.

At the top is the 2465 DVS with integral GPIB interface, DMM, Counter/Timer/Trigger-Word Recognizer and Video measurement capabilities.

The GPIB interface lays the groundwork for a programmable semiautomatic measurement package with extended capabilities. Result: you use computer power and human pattern recognition to best advantage in your test and measurement applications.

The Counter-Timer-Trigger (CTT)-Word Recognizer combination, also programmable, is ideal for measuring frequency, period, pulse width, time between events and more—automatically. And for the first time in a portable scope—Boolean triggering.

The 17-bit Word Recognizer probe, enabling you to count, trigger and determine the frequency of word occurrences, is a valuable tool in digital applications.

The fully programmable 4½ digit, autoranging DMM provides dc and ac (RMS) volts and current, dBm, dBV, resistance and temperature. All measurements can be averaged and smoothed for CRT display or bus transmission.

For television waveforms, including "high definition," the 2465 DVS enables easy display of any line or field regardless of protocol. Other unique features are a back-porch clamp and CRT readout of the triggering field and line numbers. The step, frequency and phase response, and overdrive recovery are comparable to waveform monitors.

The GPIB, a talker/listener, provides programmability for the scope and all its extended measurement capabilities. It can transfer readout displayed measurements and accept operator prompting messages.

The 2465 DMS and 2465 CTS are special editions with different feature sets. The 2465 DMS provides all the capabilities of the DVS except TV. The 2465 CTS provides all the features of the DVS except TV and DMM.

These new 2465 Special Editions are based on everything that made the 2465 the

Features	2465 DVS	2465 DMS	2465 CTS
GPIB	STD	STD	STD
Counter/Timer/Trigger-Word Recognizer	STD	STD	STD
P6131 (4 probes)	STD	STD	STD
DMM	STD	STD	—
TV	STD	—	—
Rackmount*	*	*	*

*Available at time of order and can be configured with the other capabilities.

NOTE: Extended measurement capabilities may be ordered on either the 150 MHz 2445, or 300 MHz 2465 oscilloscopes.

world's most popular high performance portable scope.

You get auto level "hands-off" triggering. True four channel capability with 300 MHz bandwidth at the probe tip. Δ-Time delayed sweep accuracy up to 0.5%. On-screen vertical and horizontal cursors. Extensive CRT readouts, including time, voltage, phase, ratios and trigger level.

Plus, the industry's first 3-year warranty on all parts and labor, including the CRT.

See refinements in productivity, automation, accuracy and performance like you've never seen before. Call your Tek sales engineer today for a demo. For literature call the Tek Literature Center toll-free at 1-800-547-1512. (In Oregon, 1-800-452-1877).

The 2465 Special Editions will be unveiled at WESCON. See them at Booth 1428.

Tektronix®
COMMITTED TO EXCELLENCE

To each.

P-CAD Turns Your IBM PC Into a CAE Workstation.

There's just one thing wrong with the productivity breakthrough promised by CAE: the high price of the workstations makes you wait in line for a turn. And how good is improved productivity when it's only available late at night?

Now P-CAD Systems turns the CAE promise into reality. By putting full-function electronic design automation right on your desk. P-CAD's CAE software runs on a standard IBM PC or XT. With no custom

hardware required. (How many CAE suppliers can make *that* statement?)

Everything You've Wanted in a CAE Workstation. And Less.

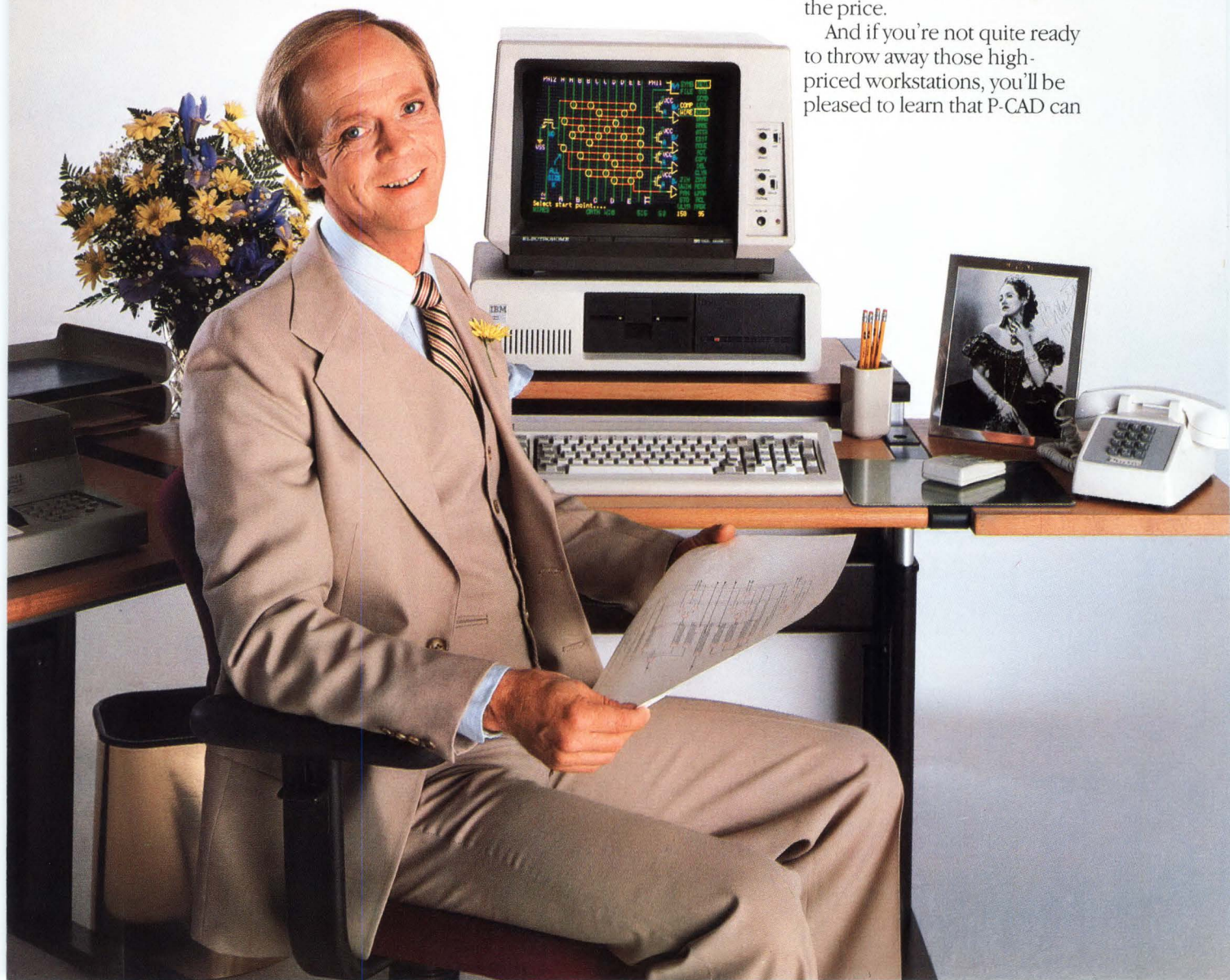
You may think that turning a PC into a CAE workstation requires compromises in functionality. Not so. P-CAD provides complete, end-to-end design capability for CAE, meeting the exacting needs of even VLSI concept design. With features like true hierarchical logic design, real-time 'dragging' and rubber-banding of design data on the screen,

extensive attribute support, and an ever-growing library of gate array, standard cell, and off-the-shelf components.

P-CAD maintains data integrity all the way from conceptual design to manufacturing and back. An innovative intelligent database keeps track of all your design interrelationships, monitoring your logical and physical network in real time. And we're adding capabilities like Timing Verification and Behavioral Simulation to keep P-CAD CAE software at the state of the art.

In short, P-CAD gives you everything you'd expect to find in a CAE workstation costing \$50,000 to \$100,000. Except the price.

And if you're not quite ready to throw away those high-priced workstations, you'll be pleased to learn that P-CAD can



His own.

act as a front end system, too. We provide numerous entry and exit points for easy data import and export with other CAE systems. Our logic design language, LDL, represents a major advance over ordinary graphic programming, creating actual hierarchical logic through software. Through LDL, you can even transport an entire component library to the P-CAD system, often saving months of digitizing.

We Speak Your Language.

P-CAD was founded by CAD users. We were the first CAE company to deliver high-end

functionality on the PC. And the only company to offer



a complete, end-to-end solution. And we know the importance of continuing product innovation to keep you on the leading edge to which you've become accustomed.

If you're like most engineers, you want to work at your own pace. On your own

system. On your own desk. And now, you can. With P-CAD. Call toll-free 800-882-7535 (in CA: 408-354-7193) for your nearest P-CAD representative. He'll arrange your own free demonstration with no obligation.

Go on. Make your day.

*Electronic
Design Automation*

p-cadTM
PERSONAL CAD SYSTEMS INC.

981 University Ave.
Los Gatos, CA 95030
(408) 354-7193 TELEX 278866

CIRCLE 236



© 1984, Personal CAD Systems, Inc.
IBM is a registered trademark of
International Business Machines Inc.

Switching supplies fit inside Winchester, floppy-disk drives

Two switching power supplies that are only half the size of popular industry supplies are designed for disk drives, modems, printers, small instruments, microprocessor systems, and other space-critical applications.

The 40-W Micro 40 is just 5 by 3 by 1 in. and delivers +5 V dc at 3 A, +12 V dc at 3 A peak (for hard-disk and streaming-tape applications), and -12 V dc at 0.5 A, which is linearly postregulated. It can be mounted within the outline of a standard Winchester drive.

Standing 5 by 2 by 1 in., the 20-W Micro 20 puts out +5 V dc at 2.2 A and +12 V dc at 350 mA; the latter are linearly postregulated. Intended for use in floppy-disk drives, this unit is useful for other small applications as well.

The switching frequency is 30 kHz and the efficiency is about 70%. The input voltage range is between 80 and 130 or 180 and 260 V ac.

Though small, both supplies meet important radiation specifications, including FCC levels A and B and VDE level A for conducted EMI

without a cover or shield. As for safety, both meet UL and CSA standards. In addition, the Micro 40 meets VDE and IEC safety specifications.

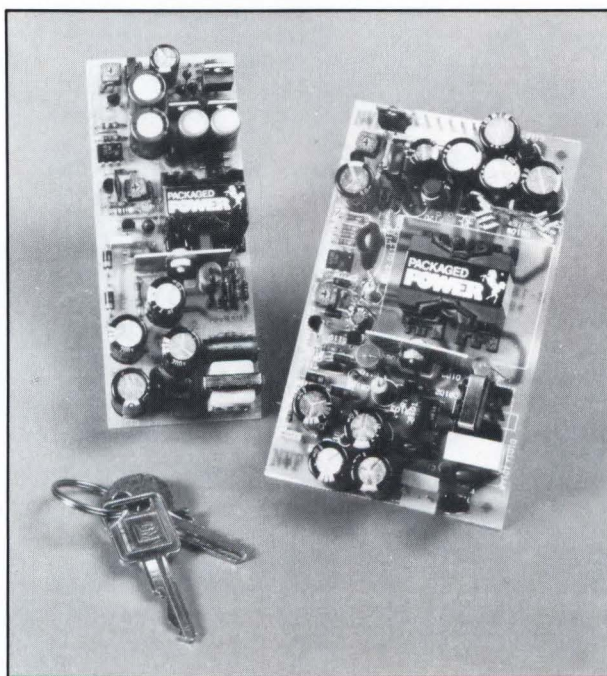
Other features of both are built-in balun-and-capacitor input line filters, crowbar overvoltage protection on the 5-V outputs, and short-circuit protection on all outputs. (A balun is a transformer that presents a high impedance to common-mode signals and a low impedance to differen-

tial-mode signals. Basically two coils with a common core, one in each side of the ac line, it reduces common-mode voltage noise.)

In OEM quantities, the Micro 20 costs \$39, and the Micro 40 is priced at \$49. Delivery takes 6 to 12 weeks after receipt of an order.

Computer Products Inc., Compower Division, 2220 Lundy Ave., San Jose, Calif. 95131; Tazz Pettebone, (408) 942-1600.

CIRCLE 308



Heather Bryce

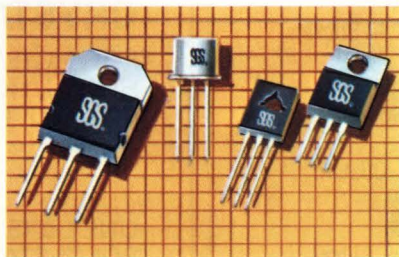


SGS comes through again with more Power MOS Packages than anyone else.

Fast driving, easy switching SGS-developed N-channel Power MOS is ready now — ready to handle a variety of tough, high-speed assignments with the industry's widest range of packages, including very low- and very high-power plastic encapsulations.

The SGS Power MOS design features two optimized technologies (100V and 400V), plus ion implantation and planar edge structure. Working currents are available up to 10A. Resistances in the "ON" condition range from 20 ohms to .07 ohms. Threshold voltages for all devices are from 1.5V minimum to 4V maximum.

The extensive line of SGS Power MOS transistors is designed for high-speed switching applications. Because Power MOS transistors function as majority carrier devices without storage time, they are faster than comparable bipolar transistors. In addition, SGS Power MOS devices are more rugged than bipolar devices since there is no secondary breakdown. The increased switching speed of these transistors makes them ideally suited for applications such as



TO-218, TO-220,
SOT-82, TO-3 & TO-39
PACKAGES NOW AVAILABLE.

switchmode power supplies, motor speed control and stepper motor control.

SGS Power MOS transistors have low voltage drive requirements, just above the threshold voltage, and high input impedance, allowing the transistors to be driven very easily from a voltage generator that need only provide an adequate charge of the input capacitance. Driving is not only simple, but practically independent of load current.

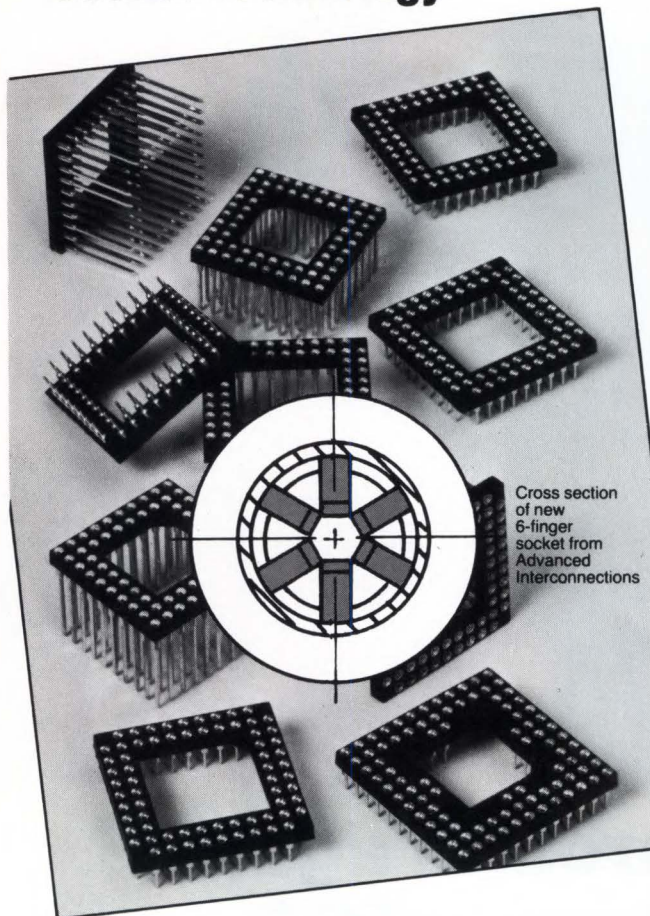
So, if you want faster switching, easier driving capabilities, plus outstanding thermal stability, you want Power MOS. If you want more choices, including easy hybrid assembly with SOT-82, SGS is the only way to go. We back you with 5 packages (TO-218, TO-220, SOT-82 plastic and TO-3, TO-39 metal) and over 100 different devices covering 9 voltage ranges (50V to 500V) — all interchangeable with comparable competitors' products. And that's just the beginning. There are a lot more SGS Power MOS packages down the road.

For more information, contact SGS: (602) 867-6100/1000 East Bell Road, Phoenix, Arizona 85022. Or call the sales office nearest you:

Atlanta, GA (404) 446-8686; Austin, TX (512) 459-4545; Boston, MA (617) 890-6688; Chicago, IL (312) 490-1890; Dallas, TX (214) 733-1515; Indianapolis, IN (317) 241-1116; Irvine, CA (714) 863-1222; Long Island, NY (516) 435-1050; Los Angeles, CA (818) 991-2900; Minneapolis, MN (612) 835-1347; Phoenix, AZ (602) 867-6100; Poughkeepsie, NY (914) 473-2255; San Francisco, CA (408) 727-3404; Sao Paulo, Brazil (11) 853-5062.

Created by Martz & Assoc.

Advance Your P.G. Array Socket Technology



Cross section of new 6-finger socket from Advanced Interconnections

Now only 2½ oz. avr. Insertion Force!

- Lowest Insertion and Extraction Force P.G.A. Sockets now available!
- Only 2½ oz. average insertion force per pin.
- New 6-Finger Beryllium Copper Contacts offer 6 points of reliable contact.
- Over 60 P.G.A. footprints, 12 to 289 pins. Custom designs delivered in 2 to 3 weeks.
- Most sockets available with molded bodies.
- Terminals available in Standard, Super-Low, Ultra-Low profiles and Wire-Wrap®.
- Insulators in molded polyester, .062 glass epoxy, or Peel-A-Way™ in Mylar® or Kapton®.

*Call, Write or TWX for
latest 20-page Catalog
of Advanced Sockets*



ADVANCED INTERCONNECTIONS

5 Division Street, Warwick, RI 02818
(401) 885-0485 TWX 710 3820400

CIRCLE 238

POWER PEOPLE

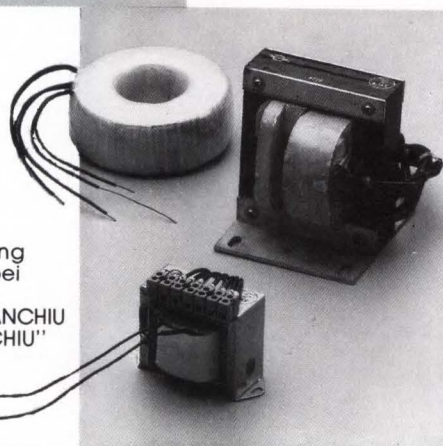


Ferro-resonant transformer (CVT), Power transformer for UL 114 & UL 478 appliances and Torroidal power transformers in 1KVA and under. Computerized line and lab testing. Control systems, data processing, other industrial applications. Strong design and lamination. Join our list of brand-name OEM customers today.

Contact:

**KWAN CHIU
RADIO MFG.
CO., LTD.**

326, Sec. 3, Chung
King N. Rd., Taipei
Taiwan, R. O. C.
Telex: 27640 KWANCHIU
Cable: "KWANCHIU"
TAIPEI



CIRCLE 239

FROM

ovenaire

MINIATURE CRYSTAL OVENS

FOR HC18/U, HC25/U,
HC42/U, HC43/U
CRYSTAL HOLDERS



ONLY 0.75" DIA. X 0.562" HIGH.
SOLID STATE PROPORTIONAL
CONTROL.

CHOICE OF SET POINT TEMPERATURES
FROM 35°C to 95°C in 5°C INCREMENTS.
ADJUSTABLE SET POINT AVAILABLE.

CHOICE OF OPERATING VOLTAGES FROM
5 VDC TO 30 VDC. LOW POWER CONSUMPTION - 0.5-0.9 WATTS AT 25°C TYPICAL.

FAST PROTOTYPE DELIVERY

FOR DETAILS CALL DR. BILL MORROW 804-977-8050

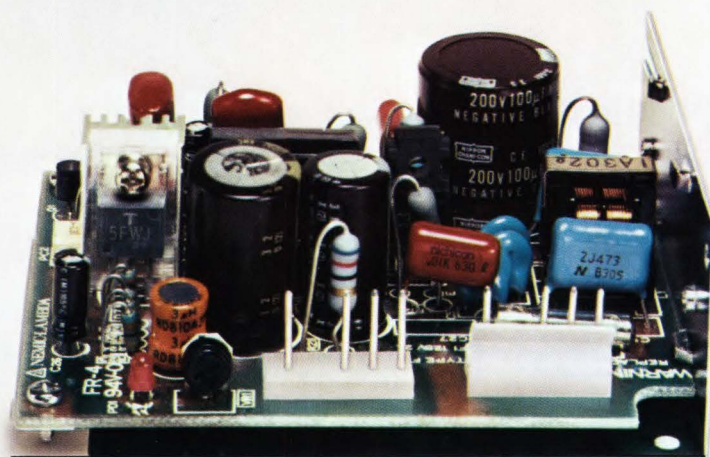
OVENAIRE-AUDIO-CARPENTER

706 Forrest St. Charlottesville Va. 22901
804 977-8050 TWX 510-587-5461

CIRCLE 240

INTRODUCING THE FIRST SWITCHING POWER SUPPLY FOR UNDER \$20.

At \$19, Lambda's LV Series can even replace low-cost linear supplies.



NEW LV SERIES	100 QTY	1000 QTY
5V @ 2A	\$26.00	\$19.00
5V @ 3A	31.50	22.25
5V @ 5A	45.00	26.50
5V @ 10A	56.00	38.00

30 models, single and triple output available. Up to 48 volts. Up to 10 amps.
One day delivery.

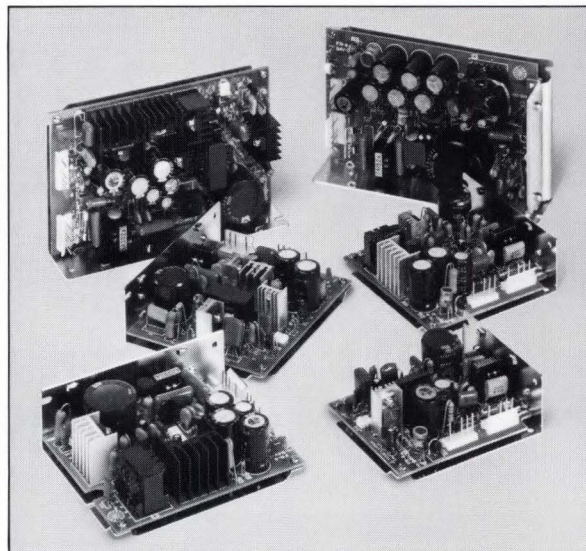
Λ LAMBDA ELECTRONICS
BETTER IN THE LONG RUN.

Lambda's LV Series prices make the build or buy decision tougher than ever.

With prices starting at \$19.00, the LV Series is an ideal power supply for many OEM applications.

The LV Series features molex-type input-output connectors for ease in wiring and installing in your OEM equipment. An indicator light provides quick verification of output voltage for in-house and field service personnel.

With 30 models to choose from, the LV Series provides a standard solution to your custom output requirements. All models are in stock for one day delivery.



Voltage and Current Ratings

LV SERIES SINGLE OUTPUT

MODEL	REGULATION (line, load)	RIPPLE (mV RMS)	MAX CURRENT (AMPS AT)			PKG. SIZE	DIMENSIONS (Inches)	Qty. 1	PRICE	Qty. 1000
			40°C	50°C	60°C				Qty. 100	
5V ± 5% ADJ.										
LVS-42-5B	0.4%, 0.8%	15	2.0	2.0	1.5	42	1.38 x 3.82 x 3.13	\$41.00	\$26.00	\$19.00
LVS-43-5B	0.4%, 0.8%	15	3.0	3.0	2.25	43	1.38 x 3.82 x 3.88	47.00	31.50	22.25
LVS-44-5B	0.4%, 0.8%	15	5.0	5.0	3.75	44	1.38 x 3.82 x 4.59	72.00	45.00	26.50
LVS-45-5B	0.4%, 0.8%	15	10.0	10.0	7.5	45	1.38 x 3.82 x 6.26	98.00	56.00	38.00
12V ± 5% ADJ.										
LVS-42-12B	0.4%, 0.8%	15	0.9	0.9	0.67	42	1.38 x 3.82 x 3.13	\$41.00	\$26.00	\$19.00
LVS-43-12B	0.4%, 0.8%	15	1.3	1.3	0.97	43	1.38 x 3.82 x 3.88	47.00	31.50	22.25
LVS-44-12B	0.4%, 0.8%	15	2.1	2.1	1.57	44	1.38 x 3.82 x 4.59	72.00	45.00	26.50
LVS-45-12B	0.4%, 0.8%	15	4.2	4.2	3.15	45	1.38 x 3.82 x 6.26	98.00	56.00	38.00
15V ± 5% ADJ.										
LVS-42-15B	0.4%, 0.8%	15	0.7	0.7	0.52	42	1.38 x 3.82 x 3.13	\$41.00	\$26.00	\$19.00
LVS-43-15B	0.4%, 0.8%	15	1.0	1.0	0.75	43	1.38 x 3.82 x 3.88	47.00	31.50	22.25
LVS-44-15B	0.4%, 0.8%	15	1.7	1.7	1.27	44	1.38 x 3.82 x 4.59	72.00	45.00	26.50
LVS-45-15B	0.4%, 0.8%	15	3.4	3.4	2.55	45	1.38 x 3.82 x 6.26	98.00	56.00	38.00
24V ± 5% ADJ.										
LVS-42-24B	0.4%, 0.8%	15	0.5	0.5	0.37	42	1.38 x 3.82 x 3.13	\$41.00	\$26.00	\$19.00
LVS-43-24B	0.4%, 0.8%	15	0.7	0.7	0.52	43	1.38 x 3.82 x 3.88	47.00	31.50	22.25
LVS-44-24B	0.4%, 0.8%	15	1.1	1.1	0.82	44	1.38 x 3.82 x 4.59	72.00	45.00	26.50
LVS-45-24B	0.4%, 0.8%	15	2.1	2.1	1.57	45	1.38 x 3.82 x 6.26	98.00	56.00	38.00
28V ± 5% ADJ.										
LVS-42-28B	0.4%, 0.8%	15	0.4	0.4	0.3	42	1.38 x 3.82 x 3.13	41.00	26.00	19.00
LVS-43-28B	0.4%, 0.8%	15	0.6	0.6	0.45	43	1.38 x 3.82 x 3.88	47.00	31.50	22.25
LVS-44-28B	0.4%, 0.8%	15	0.9	0.9	0.67	44	1.38 x 3.82 x 4.59	72.00	45.00	26.50
LVS-45-28B	0.4%, 0.8%	15	1.8	1.8	1.35	45	1.38 x 3.82 x 6.26	98.00	56.00	38.00
48V ± 5% ADJ.										
LVS-42-48B	0.4%, 0.8%	15	0.2	0.2	0.15	42	1.38 x 3.82 x 3.13	41.00	26.00	19.00
LVS-43-48B	0.4%, 0.8%	15	0.3	0.3	0.22	43	1.38 x 3.82 x 3.88	47.00	31.50	22.25
LVS-44-48B	0.4%, 0.8%	15	0.5	0.5	0.37	44	1.38 x 3.82 x 4.59	72.00	45.00	26.50
LVS-45-48B	0.4%, 0.8%	15	1.0	1.0	0.75	45	1.38 x 3.82 x 6.26	98.00	56.00	38.00

Voltage and Current Ratings (con't.)

LV SERIES TRIPLE OUTPUT

MODEL	Volt Vo	REGULATION (line, load)	RIPPLE (mV RMS)	MAX CURRENT (AMPS AT)			PKG. SIZE	DIMENSIONS (Inches)	Qty. 1	PRICE	
				40°C	50°C	60°C				Qty. 100	Qty. 1000
5V ± 12V FIXED											
LVT-40-133B	+ 5	0.4%, 2%	15	2.0	2.0	1.0	40	1.38 x 3.82 x 4.47	\$60.00	\$37.50	\$24.00
	+12	0.4%, 2%	15	0.3	0.3	0.15					
	-12	0.4%, 2%	15	0.2	0.2	0.1					
LVT-41-133B	+ 5	0.4%, 2%	15	3.0	1.5	—	41	1.46 x 3.82 x 6.05	\$88.00	\$56.00	\$35.00
	+12	0.4%, 2%	15	1.2	0.6	—					
	-12	0.4%, 2%	15	0.3	0.15	—					
5V ± 15V FIXED											
LVT-40-144B	+ 5	0.4%, 2%	15	2.0	2.0	1.0	40	1.38 x 3.82 x 4.47	\$60.00	\$37.50	\$24.00
	+15	0.4%, 2%	15	0.3	0.3	0.15					
	-15	0.4%, 2%	15	0.2	0.2	0.1					
LVT-41-144B	+ 5	0.4%, 2%	15	3.0	1.5	—	41	1.46 x 3.82 x 6.05	\$88.00	\$56.00	\$35.00
	+15	0.4%, 2%	15	1.2	0.6	—					
	-15	0.4%, 2%	15	0.3	0.15	—					
5V + 12V -5V FIXED											
LVT-40-131B	+ 5	0.4%, 2%	15	2.0	2.0	1.0	40	1.38 x 3.82 x 4.47	\$60.00	\$37.50	\$24.00
	+12	0.4%, 2%	15	0.3	0.3	0.15	40				
	-5	0.4%, 2%	15	0.2	0.2	0.1	40				
LVT-41-131B	+5	0.4%, 2%	15	3.0	1.5	—	41	1.46 x 3.82 x 6.05	\$88.00	\$56.00	\$35.00
	+12	0.4%, 2%	15	1.2	0.6	—					
	-5	0.4%, 2%	15	0.3	0.15	—					

LV Series Specifications

DC Output

Voltage range shown in tables.

REGULATED VOLTAGE

regulation, line . . . 0.4% for input variations from 85-132VAC or 132-85 VAC.

regulation, load . . . 0.8% for LVS models, 2% for LVT models (from no load to full load).

ripple and noise . . . 15mV RMS for all models with either positive or negative terminal grounded. 150mV pk-pk for 5V models; 300mV pk-pk for 12V through 48V models.

temp. coeff. 0.02%/°C for single output models and 5V output of triple output models. 0.03%/°C for other two outputs of LVT models.

AC Input 85-132VAC, 47-440 Hz.

Efficiency 62% minimum.

DC Input 110-175 VDC.

Overshoot

No overshoot at turn-on, turn-off or power failure.

Ambient Operating Temperature

0-60°C with suitable derating above 50°C (see table). 0-50° for LVT-41.

Storage Temperature

-30°C to +85°C.

Overload Protection

Automatic electronic current limiting circuit with automatic recovery, limits short circuit output current to a safe, preset value, thereby protecting the load as well as the power supply when direct shorts occur. Sustained short circuit operation for more than 30 seconds may cause damage to the power supply.

Hold Up Time

Output will remain within regulation limits for 16 msec typical after loss of AC power at full load with nominal output voltage and 85VAC input at 60Hz.

Overvoltage Protection

Standard on all single output LVS-44, LVS-45 models.

Input Fuse

A 2 amp slo-blo fuse in the AC input line protects the input wiring to the power supply. Overload of power supply does not cause fuse failure.

Cooling

Convection cooled, no fans or blowers needed.

DC Output Controls

Simple screwdriver adjustment over the entire voltage range of single output models. Triple output models are fixed.

Output Status Indicator

LED indicates presence of voltage on single output models and on +5V output of triple models.

Mounting

Two mounting surfaces, three mounting positions. Air circulation may be required when mounting in confined areas.

Input and Output Connections

Molex connectors. AC input—Molex Type 5289-4A. DC output—Molex Type 5287-4A. (Molex Type 5287-5A on triples). AC input terminals are marked "H" and "N" for hot side and neutral respectively.

Physical Data

Package Model	Weight		Size Inches
	Lbs. Net	Lbs. Ship	
LVT-40	0.84	1.0	1.38 x 3.82 x 4.47
LVT-41	1.0	1.13	1.46 x 3.82 x 6.05
LVS-42	0.44	0.52	1.38 x 3.82 x 3.13
LVS-43	0.55	0.64	1.38 x 3.82 x 3.88
LVS-44	0.70	0.82	1.38 x 3.82 x 4.59
LVS-45	0.86	1.0	1.38 x 3.82 x 6.26

Finish

Gray, Fed. Std. 595 No. 26081.

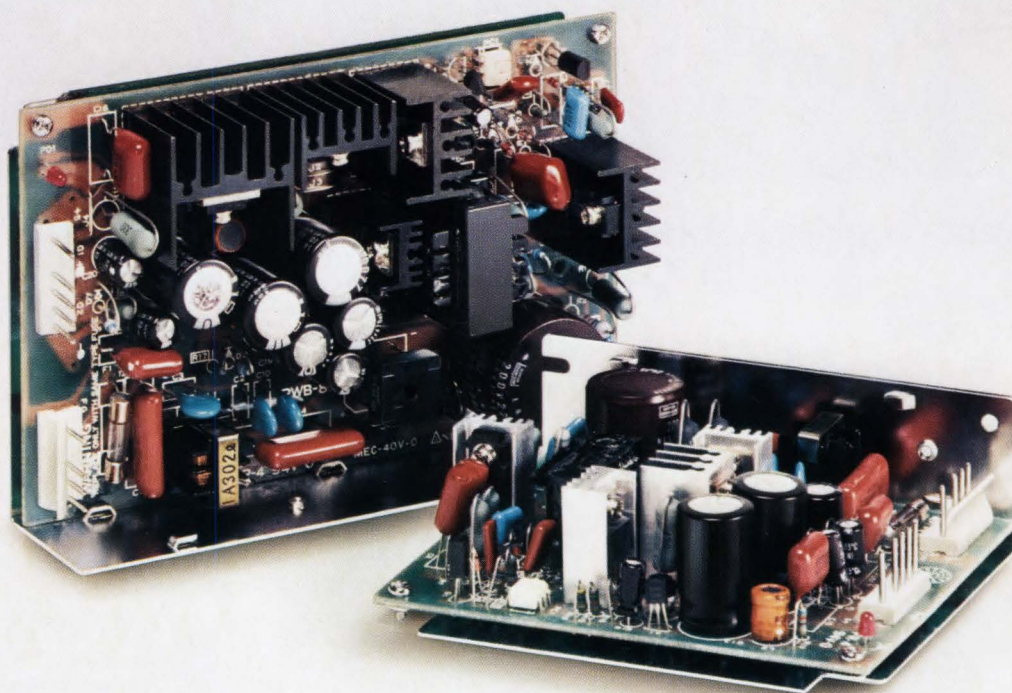
Guarantee

90-day guarantee includes labor as well as parts. Guarantee applies to operation at full published specifications at end of 90 days.

UL, CSA

Under evaluation.

NEW LV SERIES INCLUDES SIX TRIPLES IN TWO MODELS: 16 Watts, \$24; 33 Watts, \$35



TO ORDER CALL YOUR LOCAL LAMBDA SALES ENGINEER.

To contact the direct-factory Lambda Sales Engineer responsible for your account and located in your area, or to contact Customer Service for price, delivery or placing purchase orders, call as follows:

IN EASTERN UNITED STATES (Shaded area)

1-800-LAMBDA-4

(In New York and Puerto Rico
Dial 516-694-4200)

IN WESTERN UNITED STATES

1-800-LAMBDA-5

(In Arizona, Alaska and
Hawaii, Dial 602-746-1011)



ADDRESS ALL CUSTOMER
CORRESPONDENCE TO:
LAMBDA ELECTRONICS
515 BROAD HOLLOW ROAD
MELVILLE, NY 11747
TWX: 510-224-6484 or 6177

IN CANADA

Lambda Electronics
100C Hymus Blvd.
Pointe-Claire
Quebec H9R 1E4

1-800-361-6130

TWX: 610-422-3029

In Metropolitan Montreal
514-697-6520

In British Columbia
112-800-361-6130



**LAMBDA
ELECTRONICS**

DIVISION of **Veeco** INSTRUMENTS INC.

good partners—aerosols and electronics

For years, Miller-Stephenson has specialized in aerosols designed exclusively for the electronics industry. Our high-purity spray containers suit the electronics style. Safe. Pure. Compact. Portable. Convenient. Easy to apply. Sealed containers provide uncontaminated solvent, spray after spray. Here are some of our star performers. Wouldn't one meet your specific need?

aerosol solvent cleaners

Our wide range of high-purity cleaners are designed to meet the specific soil-removal requirements of electronic procedures.

flux remover and Cobra® spray brush

Freon® TMC Flux Remover and Heavy Duty Flux Remover flush all types of organic flux off PCBs and other electronic assemblies without recontamination. With the Cobra Spray Brush attached, the flux remover becomes an efficient system combining chemical and scrubbing actions.

release agents/dry lubricants

The active ingredient for our release agents is a Teflon-like material which is dispersed in various solvents.

freezing and fault isolation products

Our freezing agents are packed with long pinpoint applicators, allowing isolation of single components in heat-cold intermittence testing.

conformal protective coatings

Since coating requirements are varied, Miller-Stephenson has ready to use aerosol coatings of acrylic, silicone, urethane and varnish. All provide excellent electrical insulation and moisture resistance.

conductive coatings

To meet RFI/EMI regulations, we also offer new conductive coating sprays, which provide low cost protection and are compatible with many substrates.

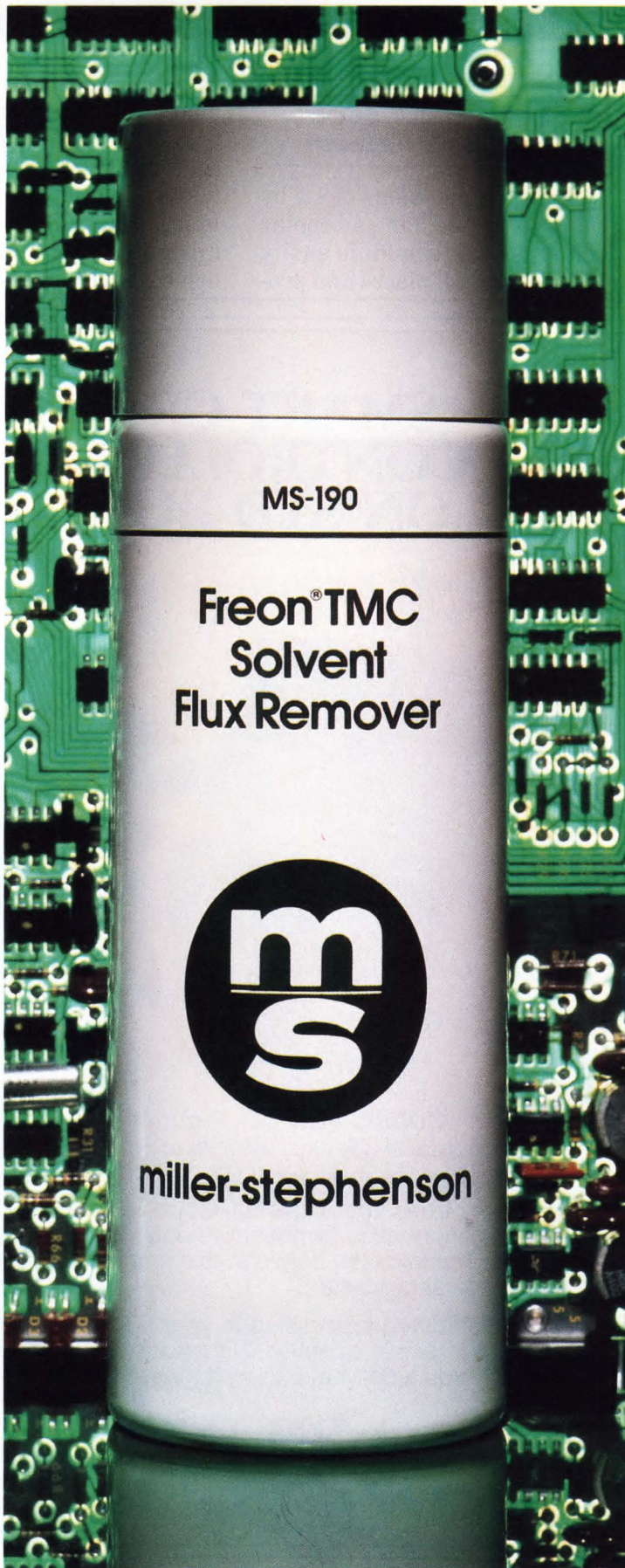
and more in our catalog

Our catalog also offers tape head cleaner, contact cleaners, anti-static agents and other products, complete with specification charts. Write: Miller-Stephenson Chemical Company, Inc., George Washington Highway, Danbury, Conn. 06810. Or call (203) 743-4447.

miller-stephenson

LOS ANGELES/CHICAGO/TORONTO/DANBURY

"Freon" is DuPont's registered trade mark for its fluorocarbon compounds.



POWER

Small motor driver delivers 5 A/phase

With dimensions of 1.5 by 3.3 by 6.75 in., a bipolar chopper drive module easily fits into small places and pro-

duces uniform outputs of 0.5 to 5 A per phase, making it compatible with a wide range of stepping motor sizes. The Model 3025's high-performance output can be used to drive motors up to 34,000 full

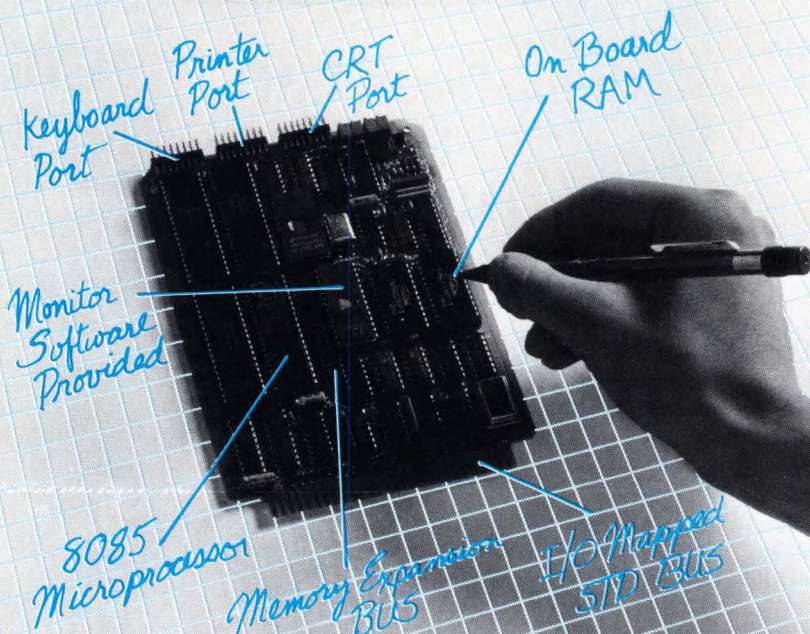
steps/s. Full- or half-stepping modes are selectable via an internal solderless jumper.

The drive module operates in a noncirculating mode that forces recirculated current during chopping to flow directly into the power supply through free-wheeling diodes. This produces a uniform current decay that is independent of the motor winding inductance. It also accepts TTL open-collector inputs directly from indexers and controllers.

Sigma Instruments Inc., Motion Control Division, 170 Pearl St., Braintree, Mass. 02184; (617) 843-5000.

CIRCLE 316

SMART CRT CONTROLLER ON STD BUS



Cubit's new I/O Processor controls a CRT, printer and keyboard.

Using an 8085 microprocessor with its own memory, the board frees your system CPU to race ahead of slower peripherals. Terminal-like commands permit easy communication between this smart controller and the host-processor.

Bring distributed processing to your STD Bus system for \$345 in single quantity. With stock to two week delivery, you won't have to wait long.

CuBIT INC.
Division of Proteus Industries

190 South Whisman Road, Mountain View, CA 94041
Telephone: (415) 962-8237

Power conditioner delivers 400 W

The Micro-power PC400 power line conditioner is designed to provide voltage regulation, surge and spike suppression, noise attenuation, and brownout protection for the IBM PC XT, Apple Lisa, and other fully configured workstations requiring up to 400 W of clean ac power. It produces a low-distortion sine-wave output with a voltage regulation of $\pm 2\%$ for line voltage fluctuations of $+16\%$, -30% . Long-term brownout protection is provided to 85 V ac. A low-pass LC filter and an electrostatically shielded transformer design attenuate noise and spikes.

Albar Inc., PO Box 2368, 19013 36th Ave. W., Lynnwood, Wash. 98036; (206) 771-4006. \$379.

CIRCLE 317

MR62 Subminiature Relays



Leading reliability from a world leader in computers and communications.

When space is tight and conditions tough, specify MR62. It's the reliable DIP DPDT relay that really thrives on challenge. And delivers flawless performance in far-ranging applications.

MR62 relays—with nitrogen-gas-filled, twin crossbar contacts—come encased in impermeable armor. Their PBT shield scorns almost any attack—auto

soldering, immersion cleaning, even chlorinated solvents.

Yet all this reliability stands only 0.45-inch high. And occupies a mere 0.31 square-inch of precious PC board real estate.

MR62 relays come in two series: standard and extra-high reliability.

We use our own relays in a full range of NEC computers and communications equipment. So we totally understand your need for reliability. Because our reputation, like yours, can rest on a single relay.

Contact form: 2C (DPDT).
Contact rating: 30W, 150VDC,
1.25A; 50VA, 125VAC, 1.25A.
Dimensions: H0.45" (+pins 0.13")
×W0.795"×D0.386".
Availabilities: Single Coil
Latching Type; High
Breakdown Voltage Version
(Meets FCC Part 68).

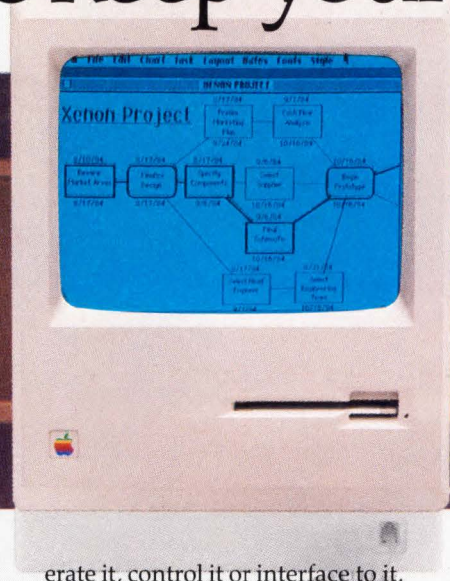
NEC America, Inc.
Electromechanical Devices Department,
532 Broad Hollow Road, Melville,
New York 11747, USA. Tel: 516-752-9700.
Telex: 144658 NEC AMER MELV.

World Products, Inc., (U.S. distributor)
19678 8th Street East, Sonoma, CA 95476,
P.O. Box 517, USA. Tel: 707-996-8201.
Telex: WORLD PROD SNOM 171715.

NEC
NEC America, Inc.

MOTOROLA

Semiconductors to keep your



Call us now, toll free, at 1-800-521-6274, and we'll show you how state-of-the-art semiconductor technologies and innovative products can keep your plan for a unique automated office system on schedule by reducing your design time.

Whether in electronic typewriters, multi-user computer workstations, local area networks or high-speed copiers, we'll help you meet challenging project schedules yet fulfill the complex market requirements of low-cost, high-performance and extreme versatility in the rapidly changing office automation world.

Call now for time-saving details.

In addition to maximizing the documented advantages of the performance-leading M68000 MPUs, call now to get further information on the extensive family of peripheral devices supporting data communication, DMA control, Local Area Network control, memory management, bus control and

parallel, serial and general purpose I/O—all there to build office automation systems quickly in a fast-moving marketplace.

Fast static RAMs can increase your office automation system's memory access speed. The MCM2167H and MCM2016H bring your MOS cache and very-high-speed, buffer memories closer to logic speeds. At 35 ns, the MCM2167H is the fastest 16K MOS static RAM in the world, and our MCM2016H is a match for any 2K x 8 at 45 ns.

We've also just announced the MCM6257, our CMOS 256K DRAM optimized for cost-effectiveness in computer main memory.

Over the phone and through the woods.

Along with providing additional memory for processor-intensive applications such as word processing, windowing and videotex, call now and Motorola will guide the way to cost-effective means of squeezing more high resolution graphics quality out of fewer integrated circuits. In fact, if it shows up on a CRT screen, Motorola has what you need to gen-

erate it, control it or interface to it.

For example, the MC6835/45 is the most widely-used CRT controller in office graphics applications.

In addition, our keyboard decoders and communication controllers have appeared in many small business computers, data entry terminals and word processing systems as well as CRT terminals.

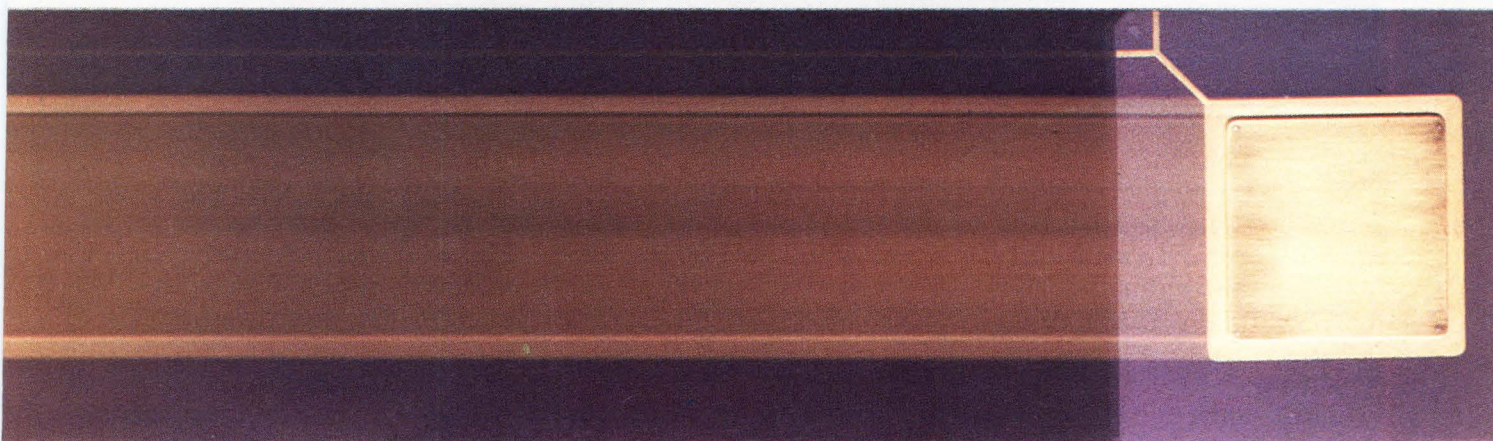
Similar applications employing raster-scan technologies are served by the MC2672 programmable video-timing controller.

In production later this year, the Raster Memory System (RMS) will generate high-performance graphics with a palette of 4096 colors for business-oriented videotex and other graphics-dependent office applications, all with a low-cost, two-chip set. The RMS system will operate on the 16-bit M68000 microprocessors and a variety of other MPUs, including the 8-bit MC6809E and MC68008 microprocessors.

To keep you out of the woods, Motorola provides a complete line of discrete semiconductors including

MOTOROLA

office system project on schedule.



optocouplers to protect your customer's office automation investment and SWITCHMODE™ products for small size, reliability and efficiency in power supplies.

This LAN is your LAN.

For data communication networks, the MC68681 dual universal asynchronous receiver/transmitter supplies data transfer rates up to 4 Mbps through two very high speed independent communication channels.

The MC68562 is a dual universal serial communication controller that offers two independent, full duplex receiver/transmitter channels and supports all the most popular protocols with data transfer rates up to 1 Mbps.

When the key requirement is cost, Motorola has the high technology answer. Our Universal Digital Loop Transceiver (UDLT) is a specialized integrated circuit system that supports point-to-point high speed data transmission. It will meet your customer's desire to avoid added data cable costs by allowing simultaneous high-speed

data and voice to be transferred over existing, common twisted-pair telephone wiring.

1-800-521-6274

Talk engineer to engineer.

It all starts with design support from our massive staff of field application engineers. Motorola has tripled the number of application engineers it has throughout the U.S. and Canada. One's near you. An application engineer who can match new semiconductor technologies and products to your office application requirements so that, with your unique designs, you can perhaps leapfrog your competition. Fast.

Each has the expertise in emerging semiconductor technologies that can electrify your new office automation ideas. Call 1-800-521-6274 and discuss your applications. Any time between 9 A.M. East Coast and 5 P.M. West Coast time, weekdays. Toll free. Talk to our specialists. They'll discuss your applications and get you in touch with a field application engineer who'll in

person describe in depth how Motorola products can cut your design and production time and keep your office automation projects on time.

Wait'll you discover what we have in store for your new design. Be it in office automation, voice/data, factory automation, entertainment equipment or any electronics-driven industry, we'll work with you at any level of chip, board or box integration through the industry's premier technical field organization. A Motorola semiconductor field application engineer is in the right location with the right expertise to help you.

Call us on it. One call. One source.

Now. For all your semiconductor needs. Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, AZ 85036.

**We're
on your
design-in
team.**

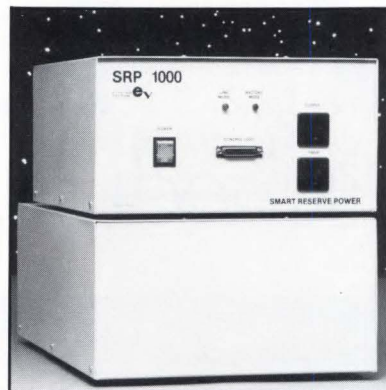


MOTOROLA

SWITCHMODE is a trademark of Motorola.

MacIntosh is a trademark of Apple Computer, Inc.

POWER

**Backup system
supplies 1000 W**

With a response time of less than 1 ms, the Model SRP 1000 delivers 1000 W of backup power to eliminate data loss due to unanticipated power outages, fluctuations in line voltage, and voltage transients.

The SRP 1000 supplies maximum power for a period of 30 minutes; up to 2 hours with an additional power pack. Ninety-five percent efficient at full load, the power supply has no noisy fans or noticeable heat dissipation. The unit also protects equipment from overvoltage transients and peak surges of up to 36 A.

Electro Vector Corp., 6555 Covey Road, Forestville, Calif. 95436; (707) 887-2292.

CIRCLE 318

**High-speed switcher
delivers up to 90 W**

Switching at a frequency of 125 kHz, a power supply delivers 60 to 90 W and can be configured with up to four outputs according to the user's needs. The unit, desig-

nated the ME090, is a compact 6.20 by 4.25 in. and stands 1.68 high. In OEM quantities, it costs at little as \$0.80 per watt.

Depending on the model, the ME090 switching supply has an efficiency rating of 70% to 85%. Its small size and high efficiency make the switcher suitable for use in computer, telecommunications, automation, and robotics applications.

Output voltages of 5, 12, 15, 24, and 48 V are available with a maximum current of 12 A. The first two outputs can be independently adjusted $\pm 5\%$, while the two remaining outputs are fixed. User-selectable input voltages are 85 to 132 V ac or 170 to 264 V ac, 47 to 63 Hz. The total regulation for each output is $\pm 0.2\%$.

MicroEnergy Inc., 1427 Centre Circle Drive, Downers Grove, Ill. 60515; (312) 620-8201.

CIRCLE 319

**7-W UHF transistor
has high power gain**

The BLU97 UHF power transistor, for use in mobile radio transmitters, combines a high power gain of 8.5 dB with an output load power of 7 W. Although specified for use at 470 MHz, the transistor operates satisfactorily in the 900-MHz band as well. When used in common-emitter amplifier circuits, the transistor has a V_{CE} of 12.5 V.

The BLU97 consists of a multibase gold-metallized structure of three BFQ68 broadband transistor crys-

tals. Emitter-ballasting resistors for each stage ensure optimum thermal performance. The transistor is supplied in a 4-lead SOT-122 package.

Philips Elcoma, PO Box 523, 5600 AM Eindhoven, the Netherlands; (040) 757005; Telex: 51573.

Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N.Y. 11802; (516) 931-6200.

CIRCLE 320

**Transient suppressor
meets IEEE STD 587**

Specifically designed to protect 120-V ac equipment from power transients, the 587B series of suppressors meets and exceeds the ac power line surge requirements of IEEE STD 587, categories A and B. The device guarantees that line-to-neutral voltages do not exceed 350 V under worst-case conditions, allowing equipment manufacturers to use lower voltage components in their system designs.

The unit is hard wired between the power switch and the power supply, rather than plugged into the front-end line cord. Current leakage at 120 V ac is 1.0 mA from line to neutral and 0.5 mA from neutral to ground. Versions of the suppressor are available with operating currents of 5, 15, and 20 A.

General Semiconductor Industries Inc., 2001 W. 10th Place, Tempe, Ariz. 85281; (602) 968-3101. From \$50 (100 units); stock to six weeks.

CIRCLE 321

Build vs. buy.

The difference between buying other word generators and ours is the difference between buying a house that still needs work and one that doesn't.

Ours doesn't.

The Pulse Data Generator already has everything you need for high-speed testing.

It's got up to 64 output channels, expandable to 256.

It generates patterns at high speed: DC to 50 MHz on all 256. And it's got a memory depth of 4K bits for every channel.

Add to that easy programmability

CIRCLE 244

(no programming experience is needed) and you've got yourself the next generation pattern generator.

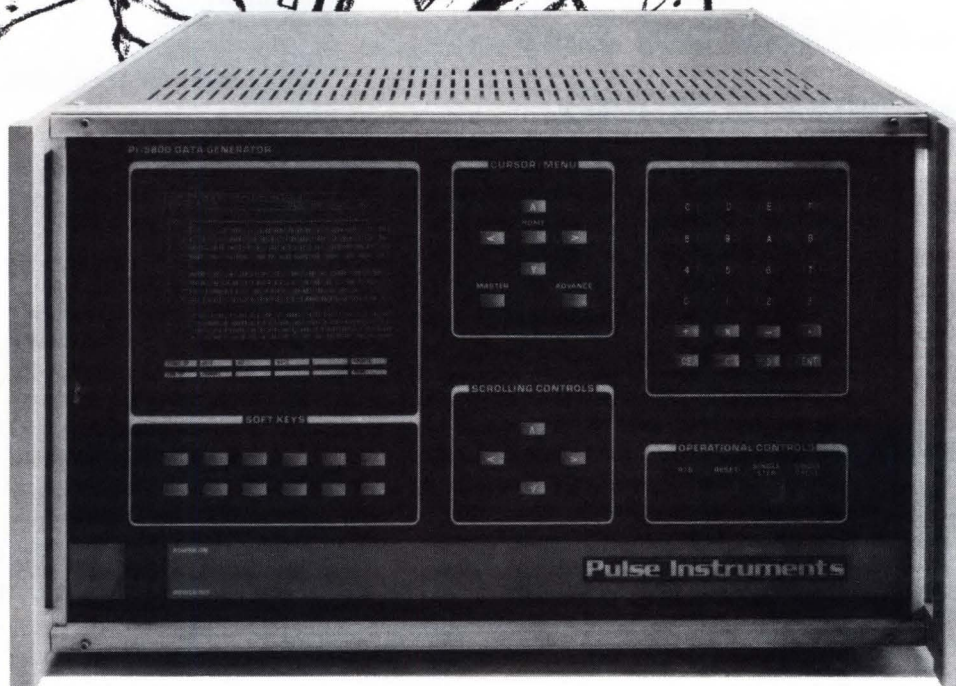
No one but Pulse offers you all the features you need for testing high-speed multichannel devices and systems.

For all the facts about our data generator, contact

Pulse Instruments,
1234 Francisco Street,
Torrance, CA 90502.
(213) 515-5330.

After all, you really didn't want a fixer-upper, did you?

Pulse Instruments



PI-5800
Data Generator

The data generator you don't have to add to.



More Competitive than Ever. Our New Line of Linear Power Supplies Offers both Additional International Features and Additional Savings.

The Worldwide Series



We realize that sometimes you need to spec power supplies for products sold throughout the world. And that other times your spec calls out supplies for domestic markets only.

Wouldn't it be nice if you could specify the same quality you've come to expect from Standard Power linear supplies to meet both domestic and international applications—and save money in the bargain, too?

That's exactly what Standard Power lets you do with our SPW Series Worldwide linear power supplies. We redesigned our SLS Series supplies to meet

the safety standards you need regardless of where your product will be marketed. These standards include VDE, UL, CSA, IEC and those of other major agencies around the world.

What's more, because of the redesign, we reduced our component and manufacturing costs and passed these savings along to you. So the SPW equivalent of our original SLS Series power supply costs you less and offers you more.

Valuable features of our SPW Series include worldwide AC input capabilities of

100/120/220/230/240 volts, line and load regulation of $\pm .05$ percent each, output ripple of five millivolts peak-to-peak, remote voltage sensing, over-voltage protection on five-volt outputs and inherently low EMI/RFI noise levels.

Now you can spec Standard Power linear supplies for applications **worldwide** and buy them off-the-shelf from your local distributor.

Send now for our latest power supply catalog. Circle the reader service number or write to us on your letterhead.



STANDARD POWER Inc.

A SUBSIDIARY OF

Acme Electric Corporation

1400 So. Village Way • P.O. Box 15447
Santa Ana, California 92705
Telephone (714) 558-8512 • TWX: (910) 595-1760

CIRCLE 245

**Form.
Function.
Five Days.**

Introducing the AMCO 500 Series

Vertical Consoles. Sloped Front Consoles. Low Silhouette Consoles. Computer Desks. Desk Top Cabinets. Blowers, Accessories & Hardware.

AMCO's new expanded 500 Series combines structural integrity with refinement in style in this quick-delivery enclosure program. Generous standard features with many optional sizes allow flexibility in design combinations. Plus... every credit approved or C.O.D. order is shipped from stock within 5 work-days!

Write or call AMCO today for your free copy of our 32 page Catalog 500-A in full color.



AMCO Engineering Co.
3801 N. Rose Street
Schiller Park, Illinois 60176

312-671-6670

"See us at WESCON - Booth #2549-2551"

CIRCLE 246

COMMUNICATIONS

RTU chip occupies less than 4 in.²

Designed for MIL-STD-1553B applications, the BUS-65112 is a complete dual-redundant remote terminal unit (RTU) that occupies less than 4 in.² of pc board real estate. The key to the super-hybrid's unprecedented size—2.1 by 1.8 in.—is three monolithic chips that use proprietary gate arrays.

The device, which interfaces with the Harris HD-15530 encoder/decoder, includes two terminal bit processors, interface logic, a protocol sequencer, and miscellaneous logic (i.e., an address parity detector circuit).

It requires two external BUS-25679 transformers and one 12-MHz TTL clock input, plus 5 V $\pm$ 15 V dc to operate. The RTU is housed in a 78-pin DIP.

ILC Data Device Corp., 105 Wilbur Place, Bohemia, N.Y. 11716; (516) 567-5600. \$1595 (one to nine units); two to five weeks.

CIRCLE 322

Protocol converter emulates IBM printer

A protocol conversion unit permits the use of high-performance, low-cost printers and other hard-copy-output devices in the IBM 3270 environment. By emu-

lating the IBM 3287 printer, the MC 80/700 converter enables the connection of high-speed dot-matrix printers or letter-quality printers, as well as various line printers, at a cost significantly below comparable IBM products.

The self-contained converter can be installed by the user without modifications to either the printer or the cluster controller. Because the MC 80/700 connects directly with the cluster controller, it is compatible with BSC or SNA/SDLC environments.

Innovative Electronics Inc., 4714 NW 165th St., Miami, Fla. 33014; (800) 327-3955 or (305) 624-1644. \$1495.

CIRCLE 323

Introducing...

The ace of chips

Corning's new MLCC chip for Hybrids, PC boards, virtually ends delamination

ACE... the Advanced Corning Electrode process that virtually eliminates delamination... is now available in MLCC chips. If you're designing or assembling hybrids, or utilizing chip-on-board construction, here's an easy way to increase system reliability.

For conventional circuit board applications,

the same high reliability continues to be available in our SPINSEAL[®] conformally coated ACE axials. With either, the failure rate from delamination is practically zero.

Also available: tantalum chip capacitors in a rugged metal can package.

For your next chip capacitor requirement specify Corning's ACE ceramic chips.

- 8 standard sizes ▪ COG/NPO, X7R & Z5U
- 50 and 100 VDC ▪ Non-precious metal electrodes
- Solderable barrier layer terminations
- 8 mm tape and reel packaging
- Corning dependability

For information, circle reader service card number, or contact:

Corning Electronics, Corning Glass Works, Raleigh, N.C. 27604
Phone: (919) 876-1100 (Customer Service)

CORNING



"BOSCHERT'S FULL LINE OF HIGH PERFORMANCE POWER SUPPLIES BEGINS WITH HIGH PERFORMANCE ENGINEERING!"

Chuck Forge
Chief Engineer, Boschert Inc.

"A quality, long lasting product is not just an engineering objective at Boschert; it's a corporate directive. And has been ever since Boschert pioneered switching power supplies for OEM applications 10 years ago.

"In fact, each Boschert design must meet corporate guidelines for low failure rate, high performance and long life. *PLUS*, it must be manufacturable at a competitive cost.

"Meeting these objectives takes longer and costs more up front, but the end result is a more reliable product with a lower overall cost to the customer."

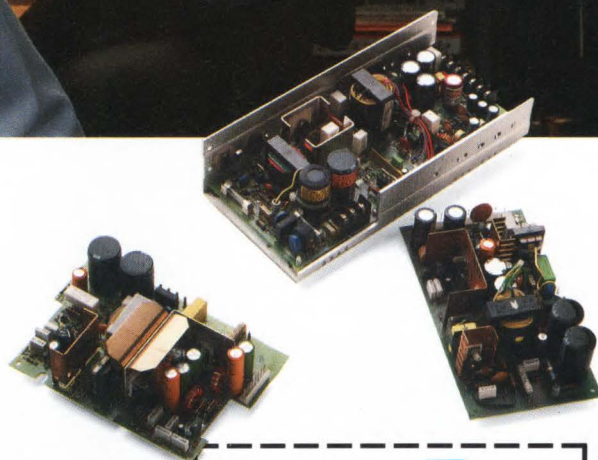
"That's why Boschert annually invests about eight percent of its revenues in engineering. And why we insist on

having experts on staff in critical areas such as magnetics, materials, components and safety.

"It's also why every Boschert product undergoes a grueling series of product evaluations, design reviews, environmental tests and manufacturing engineering reviews. As well as reviews by worldwide safety and regulatory agencies, including UL, CSA, VDE, IEC, BT, and the FCC.

"Superior design, top people, and sound procedures mean a great product. *A Boschert product.*"

For more information, send the coupon to Boschert Incorporated, 384 Santa Trinita Avenue, P.O. Box 3426, Sunnyvale, CA 94088-3426. Or call 408-732-2440.



Please send me Boschert's new full-line power supply catalog.



Boschert
A BICC Company

3ED 10/31

Name _____

Title _____ Company _____

Address _____

City _____ State _____ Zip _____

Mail coupon to Boschert Inc.
384 Santa Trinita Avenue
P.O. Box 3426
Sunnyvale, CA 94088-3426

Boschert



Boschert

POWER YOU CAN RELY ON

CIRCLE 248 "SEE US AT WESCON BOOTHS #3348 & #3350"



At Nichicon, an innovative design means a capacitor you can use today and tomorrow.

Building a better capacitor. That's what we've been doing since we delivered our first capacitor back in 1918.

And that's what we're still doing for you today, by improving capacitor designs to help save you *time and money*. By packing in greater CV in *smaller case sizes*. With *anti-solvent designs* that allow Nichicon capacitors to withstand harmful cleaning agents like Freon and Daiflon for up to five minutes—without bulky and expensive epoxy end-seals. And by exploring the realities of lead-

less chip capacitors of the future.

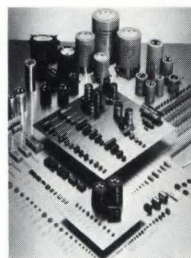
Today our SA, SL, SP, ST, MA and VX aluminum electrolytic series' are being used to replace tantalum capacitors for reasons ranging from operating reliability to size and price.

We're helping design and production engineers bring to market smaller and more powerful switching power supplies built around special capacitors with higher ripple capabilities, smaller case sizes, snap-in leads, lower ESR and impedance, plus the ability to withstand higher

operating temperatures.

But we're not stopping there. Call us today to find out how our 65 year investment in capacitors of the future can help meet your design needs today.

Value keeps us the capacitor choice.




nichicon®

927 E. State Parkway
Schaumburg, IL 60195
(312) 843-7500

© Nichicon (America) Corporation 1984

"SEE US AT WESCON BOOTHS 4017-19"

CIRCLE 249

SORENSEN TECHNOLOGY REPORT:

Multi-output power rack assemblies.

Custom service with economical off-the-shelf reliability.

Narrow Range Switchers.

Available units are: SRX 5-200 (4.75 to 5.5 Vdc up to 200 Amps), Models SSD and STM (5, 12, 15, 20, 24, 28, 36 and 48 Vdc up to 700 watts), and Model SLC-B (5, 12, 15, 20, 24, 28 and 48 Vdc up to 300 watts).

STM 5-100 (4.5 to 6 Vdc/100 A) Switcher.

Remote sensing and programming. Adjustable over-voltage and current limiting. Low ripple and noise.

QSA 120-0.5 (90-150 Vdc/

0.5 A) Linear. Remote sensing and programming. Adjustable current limiting. Less than 300 μ V rms noise and ripple.



Narrow Range

and Wide Range Linears.

Available units are Model PTM (single outputs of 5, 12, 15, 24, 28 Vdc and dual outputs of ± 12 , ± 15 Vdc up to 170 watts), and Model QSA (0-10, 14-22, 35-60, 60-90, 90-150, 150-200, and 200-330 Vdc up to 58 watts).

PTM 5-4

(4.8-5.5 Vdc/4 A) and PTM 28-2 (27-29 Vdc/2 A) Linears. Remote sensing and programming. Less than 50 μ sec transient response (10-100% step-load change). Adjustable over-voltage and current limiting.

99 off-the-shelf supplies.

Using any of 99 proven, off-the-shelf linear or switching power supplies, Sorensen quickly assembles your custom multi-output power racks without expensive custom engineering.

Pre-wired, ready-to-use.

Sorensen multi-output power assemblies use standard 19-inch racks, 3½ or 5¼ inches high and 19½ or 22½ inches deep. Front panels are customized with switches, circuit breakers, and meters as needed. Up to five separate supplies can be combined with appropriate rear-panel outputs and sense terminals. Tested and shipped ready-to-use.



Custom assembly with 488-DAP interfaces and fault monitor.

Custom cabinet assemblies.

Larger custom power assemblies in stand-up cabinets are also available using Sorensen rack assemblies or Sorensen's proven line of high wattage zero-up supplies. 65 different supplies offer voltages up to 600 Vdc and wattages up to 20 kW. Custom cabinets can include multi-output rack assemblies, zero-up programmable supplies, digital-to-analog programmers and Sorensen's custom fault monitor.

5-year warranty.

Sorensen Power Assemblies—built for maximum performance—

are backed by Sorensen's 5-year warranty and worldwide service.

Get all the facts.

Write or call today for more facts on Sorensen Custom Power Assemblies and off-the-shelf power supplies.

CIRCLE 250

SORENSEN COMPANY
676 Island Pond Road
Manchester,
New Hampshire
03103 USA
(603) 668-4500
TWX: 710-220-1339

SORENSEN
POWER SUPPLIES

RAYTHEON



THE SEALED SWITCH



Protection where it's needed

EAO believes you shouldn't have to sacrifice good looks or panel space to meet a tough environmental spec.

That's why we make 4 complete lines of sealed switches that combine rugged construction with great looking designs.

EAO's sealed switches not only meet oil/watertight standards but also block out contaminants such as sulphides from paper products and solvents used during washdowns. Plus EAO's sealed quality is available with many options in pushbutton, rotary lever or keylock models. Protection for any application.

EAO protection comes in three series of panel mounted controls: the 14, the 51 and the heavy-duty oil/watertight Series 04 plus our new Series 98: the only completely sealed low-profile keyboard switch on the market.

EAO SWITCH. You can feel the difference.

EAO

**SWITCH
CORPORATION**

P.O. BOX 552, MILFORD, CT 06460 203/877-4577
TLX EAO SWITCH MFRD 964347

CIRCLE 251

HI-RES B. & W. MONITORS

1.6 Million Pixels Non-Interlaced

- 100MHz 3 Bit Video Amp-Drive
3 Bit Planes direct (no D-A required)
- 100MHz Composite/Linear Video
- 140MHz ECL Video Amplifier
- Up to 70KHz Horizontal Scan
- 15", 17" or 19" CRT's
Landscape or Portrait
- UL Recognized
- Fast Delivery
- Cabinets Available

Shouldn't You be looking at US?

U.S. PIXEL

CORPORATION

59 Fountain Street Framingham, MA 01701
(617) 875-6958

CIRCLE 252

Moving?

1. For FASTEST service you must attach old mailing label in space below.

If mailing label is not available print your old Company name and address in this box

Please allow 6 weeks for change to take effect

2. Print your NEW business address here

NAME _____ TITLE _____

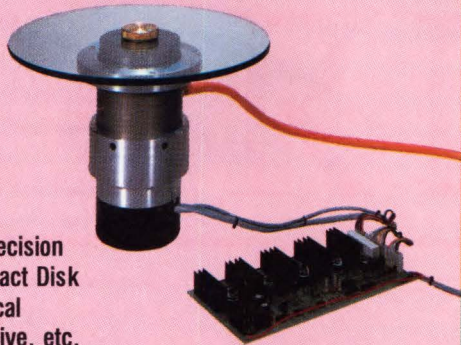
COMPANY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

3. Mail to:

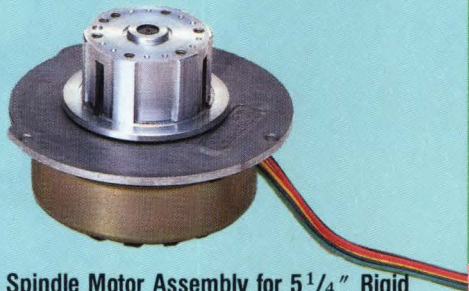
Electronic Design
P. O. Box 1418
Riverton, N.J. 08077 USA



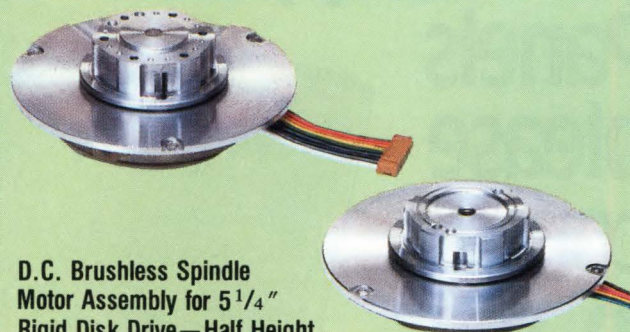
AEROSPIN™ Precision Motor for Compact Disk mastering, optical disk memory drive, etc.



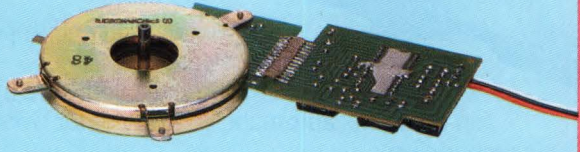
"Showa" Voice Coil Motor for positioning head assembly in rigid disk drives



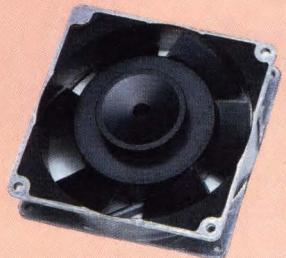
D.C. Brushless Spindle Motor Assembly for 5 1/4" Rigid Disk Drive—Full Height



D.C. Brushless Spindle Motor Assembly for 5 1/4" Rigid Disk Drive—Half Height



Spindle Motor for 3.5" and 3.25" micro-floppy disk drive



D.C. Brushless Axial Fan: available in many sizes and flow rates

See how our motors stack up against the competition.

Pioneer supplies precision spindle motors, servo motors, voice coil actuators for magnetic heads, and compact axial fans to the leading computer peripheral manufacturers.

You can choose from our wide range of off-the-shelf models. Or let our engineers assist you in developing a custom design to meet your specifications.

CIRCLE 253

Take a closer look at our products and see how they stack up against all of the rest.

Write to Pioneer International, Inc., C.P.O. Box 1791, Tokyo, Japan.



PIONEER INTERNATIONAL INC., C.P.O. Box 1791, Tokyo, Japan

"Will the engineer who ordered 347 Schottky Wire Wrapped Panels please come in. Your boards are ready."

Lucky you!

You must have known about dataCon all along. And how easily you can get your boards wired exactly the way you want.

In other words, you must have had some idea about dataCon's expertise in wiring logic panels with operating speeds up to 100 mHz.



Or perhaps you were aware of dataCon's special services designed to improve your circuit performance. Unique services such as automatic point-to-point routing where a combination of automatic and semiautomatic machines are used to locate and follow the shortest path for wiring circuit interconnections.

Gone are excessive short wire loops which only add bulk. And long "L" shaped wires are replaced by diagonal routing.

Oh yes! You knew how shorter wires diminish circuit delay, enhance electrical performance, decrease density build-up, lessen the rat's nest appearance of your boards, and make them easier for a technician to troubleshoot.

Then surely you must have heard about dataCon's ability to wire standard twisted pair, as

well as matched impedance twisted pair.

Which means you were up-to-date on dataCon's automatic equipment for twisted pair preparation.

And you were probably well-aware of dataCon's software savvy as well as computer-aided manufacturing that enables them to complete your order according to any requirement of speed, density, routing or board size.

To put it simply. You knew dataCon could give you the best of all these worlds.

Is it any wonder dataCon customers keep coming back for more? They know a good thing when they see one. And now, so do you.

Find out how dataCon's special wiring capabilities can be a special advantage for you. Write or call one of our service centers listed below.

Yes, dataCon . . . can.

dataCon

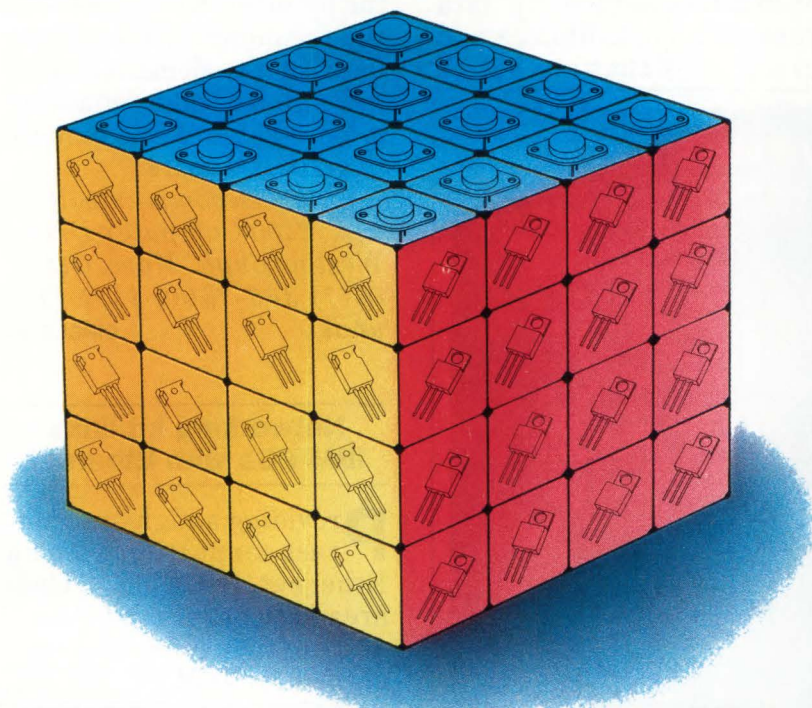
Eastern Division—60 Blanchard Rd., Burlington, MA 01803/(617) 273-5800 Telex: 951651
Western Division—20150 Sunburst St., Chatsworth, CA 91311/(818) 700-0600 Telex: 9104942197
Mid-Atlantic Division—89 Carlough Rd., Bohemia, NY 11716/(516) 589-1100 Telex: 5102220161
Mid-Western Division—502 Morse Ave., Schaumburg, IL 60193/(312) 529-7690 Telex: 722474
European Division—In der Klinge 5 D-7100 Heilbronn, W. Germany (07131) 217 12 Telex: 841 728144
1-800-521-8008—Outside Massachusetts

CIRCLE 254

TODAY'S SPECIALS

1. AUTOMATIC POINT-TO-POINT
2. BOARD 1 PROTOTYPE SERVICE
3. TWISTED PAIR WIRING
4. MILITARY SPEC WIRING
5. ELECTRICAL TESTING
6. LOW PROFILE WIRING
7. RESTRICTED AREAS
8. SPECIAL INSULATION
9. MICROSCOPIC INSPECTION
10. VARIOUS WIRE GAUGES
11. COLOR CODED VCC & GND ASSEMBLY

General Instrument solves the most puzzling power supply problems.



Part Number	V _{RM} Volts	I _F (AV) Amperes	t _r N sec	V _F Volts	Package Type*
FE8	50-200	8	35	.95	TO220
	300-600	8	35	1.20	
FE16	50-200	16	35	.95	TO220
	300-600	16	35	1.20	
FEP30	50-200	30	35	.95	TO3P
	300-600	30	35	1.20	
FE30	50-200	30	35	.95	TO3
	300-600	30	35	1.20	

*Available in negative center tap and doubler configurations.

High-voltage ranges, ultra fast T_{RR}, and low forward voltages provide the solution!

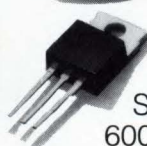
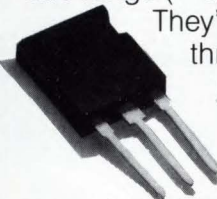
Design-in superior capability and reliability with General Instrument's fast epitaxial rectifiers. Glass passivated junctions offer high voltage plus low leakage and 35 nanosecond recovery time over a wide operating temperature range (−65°C to +150°C).

They're available in three different packages, our new high current TO3P device which saves board space and lowers assembly costs and our TO220 and TO3 configurations.

For detailed literature, samples and applications engineering information write or call

General Instrument Corporation, Discrete Semiconductor Division, 600 W. John Street, Hicksville, NY 11801 (516) 933-3713.

General Instrument Corporation: Our continued attention to rectifier development has made us an industry leader in high voltage ultra fast switching devices.



GENERAL INSTRUMENT

COMMUNICATIONS

Rf modem boasts high reliability

Providing high-performance digital communications in local area network, CATV, and factory automa-

tion installations is a crystal-controlled modem board that operates over a broadband dual-cable system. The Model 5010 offers high-speed data rates of up to 2 Mbits/s and error rates that are better

than 1 bit in 10^{12} . Performance reliability is enhanced through the use of a crystal oscillator, which eliminates the problems associated with the frequency drift usually found in rf modems. A further indication of high reliability is a predicted MTBF of more than 200,000 hours.

Link Telecommunications Inc., 2400 Computer Drive, Westborough, Mass. 01581; (617) 366-7400. \$495 (100 units).

CIRCLE 324

Cathode Ray Tubes

Thomas Electronics cathode ray tubes ... designed for Military, Commercial and Industrial applications ... from the most sophisticated avionics and photo-recording to the general computer terminal and medical display applications.

Four production facilities to serve you best in Wayne, New Jersey — Los Angeles, California — and Clyde, New York.

Send for our new full color catalog, or contact us with your specific requirements.

THOMAS ELECTRONICS

100 Riverview Drive, Wayne, NJ 07470 / 201-696-5200
TWX: 710-988-5836 / Cable: TOMTRONICS



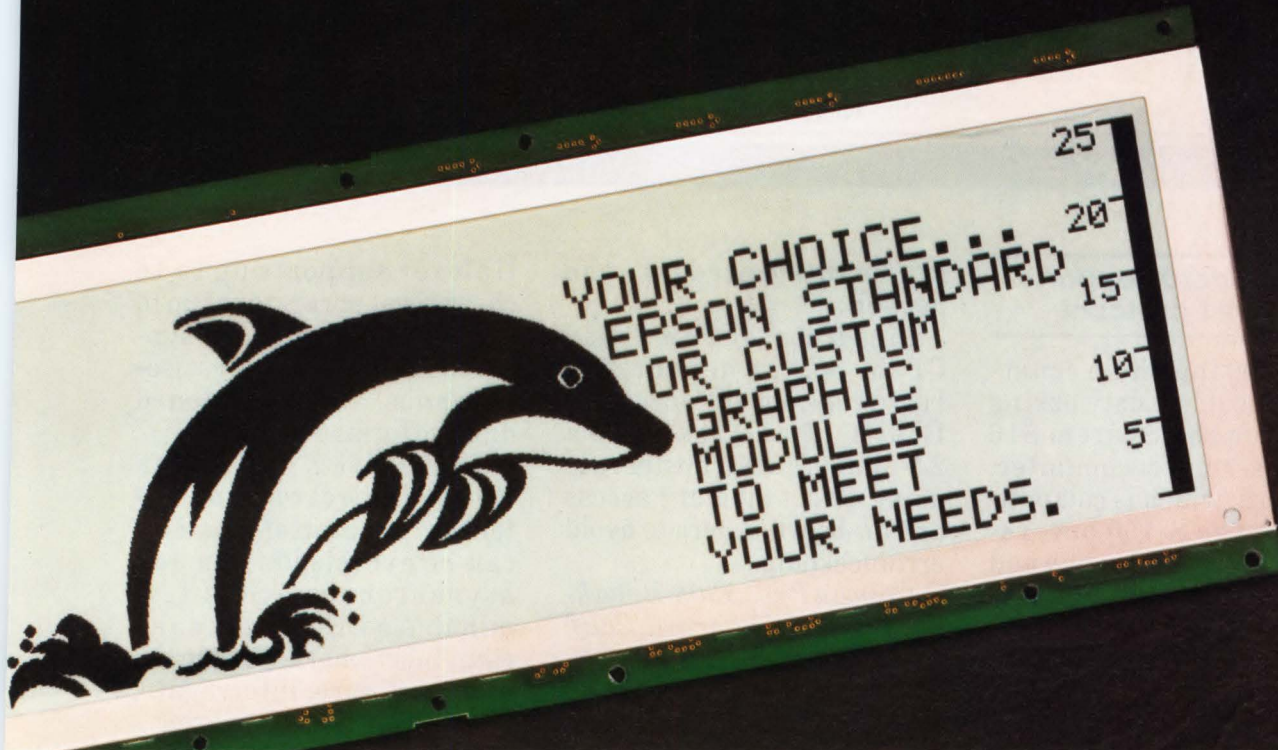
CIRCLE 576

Networking kit links IBM PCs with Ethernet

Providing a high-speed direct connection with an Ethernet/IEEE-802.3 local area network is a hardware and software package designed for IBM PC, PC XT, and Compaq computers. Called the Ethernet Direct Connect, the package includes a plug-in Ethernet controller, MS-DOS networking software based on the Xerox Network Systems/Internet Transport Protocol (XNS/ITP), and a rich set of board and network diagnostic functions. ITP/MS-DOS is completely compatible with other Interlan XNS/ITP implementations, permitting high-speed Ethernet communications between the personal computer and systems running under Unix System V; Digital Equipment's VMS, RSX-11M, and RSX-11M-Plus; and Data General's AOX/VS operating systems.

Interlan Inc., 3 Lyberty Way, Westford, Mass. 01886; (617) 692-3900.

CIRCLE 325



There's an Epsonomic answer to your flat panel display needs.

Our new 25-line LCD modules are part of it.

Epsonomics is made up of many things. State-of-the-art products are part of it. Products like this 640 by 200 dot matrix LCD display module.

Just as important as the products is the marriage of technologies that made them possible and practical. Advanced materials formulation combined with CMOS technology to produce large area, high density displays which combine contrast, viewing angle and operating temperature range with fast response time and low power consumption. That's part of Epsonomics, too.

Another part of Epsonomics is choice. Graphic display modules range from 640 x 200 to 84 x 32 dot formats which display 80 characters by 25 lines to 14 characters by 4 lines. All are available. In volume. Now. And if none of our standard graphic modules satisfy your design criteria, you can take advantage of our custom capability to meet your needs.

But Epsonomics is more than products. It's long life and dependable performance. It's on-time delivery. It's after sale service and support. It's giving that extra effort to help your gross profits grow. Because we want to grow with you.

Epsonomics. It's a way of doing business. In LCDs as in floppy drives, printers and printer mechanisms, it's a dedication to your needs that can help you control costs and increase sales. Let us help you design the Epsonomic answer that works best for you. Call or write today.

EPSON®
OEM

EPSON AMERICA, INC.
OEM Products Division
LCD Group
3415 Kashiwa Street, Torrance,
CA 90505 (213) 533-8277
TELEX: 664277



*The top lines for
your bottom line*

COMMUNICATIONS

S-100 board supports Arcnet protocol

Supporting the Arcnet-protocol is a networking board for the System 816 multi-user microcomputer. The board, which is compatible with the S-100 bus, requires only a passive hub and RG62 coaxial cable to network up to four of the microcomputers (or nodes). When an active hub is used, as many as 255 nodes can be connected over distances of up to four miles. Any microcomputer that supports Arcnet, including the CompuPro 10 and systems from IBM, Compaq, and Texas Instruments, as well as other S-100-based systems,

can be integrated into the network.

In addition to CP/M-80 and CP/M-86, the networking board runs under Concurrent DOS 8-16 and features a 2.5-Mbit/s data transfer rate using direct memory access and on-board timers to avoid error lockouts.

CompuPro, 3506 Breakwater Court, Hayward, Calif. 94545; (415) 786-0909. \$395.

CIRCLE 326

256-kbit/s multiplexer supports 16 channels

Offering a maximum aggregate speed of 256 kbits/s, a time-division mul-

tiplexer supports up to 16 channels at port rates of up to 64 kbits/s in any mix of synchronous, asynchronous, isochronous, and conditioned diphasic formats.

The DPMUX-256 has an RS-423 control terminal interface. All control functions can be exercised from any asynchronous ASCII terminal. An LED display and eight functional keys help the user configure, interrogate, and operate the multiplexer.

Dataproductions New England Inc., Barnes Park N., Wallingford, Conn. 06492; (203) 265-7151.

CIRCLE 327

Receiver ICs aim at portable cellular radio

Two rf ICs optimized for the portable cellular-radio market—a double-balanced mixer/oscillator and an FM intermediate-frequency system chip—consume less than 2.5 mA of power.

The SA602, which operates up to 500 MHz, features an on-chip oscillator capable of generating frequencies of up to 200 MHz. It has a third-order intercept point of -15 dBm and a noise figure of 5.0 dB, measured at 45 MHz. Used for intermediate frequencies of up to 10.7 MHz, the SA604 component offers a sensitivity of 0.27 μ V for a matched input of 50 Ω .

Signetics Corp., 811 E. Arques Ave., Sunnyvale, Calif. 94086; (408) 739-7700. \$2.66 (SA602) and \$6.66 (SA604) in quantities of 10,000.

CIRCLE 328

Our

PAL*

Programmers

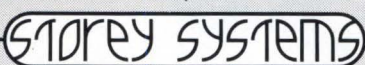
Cost

LESS





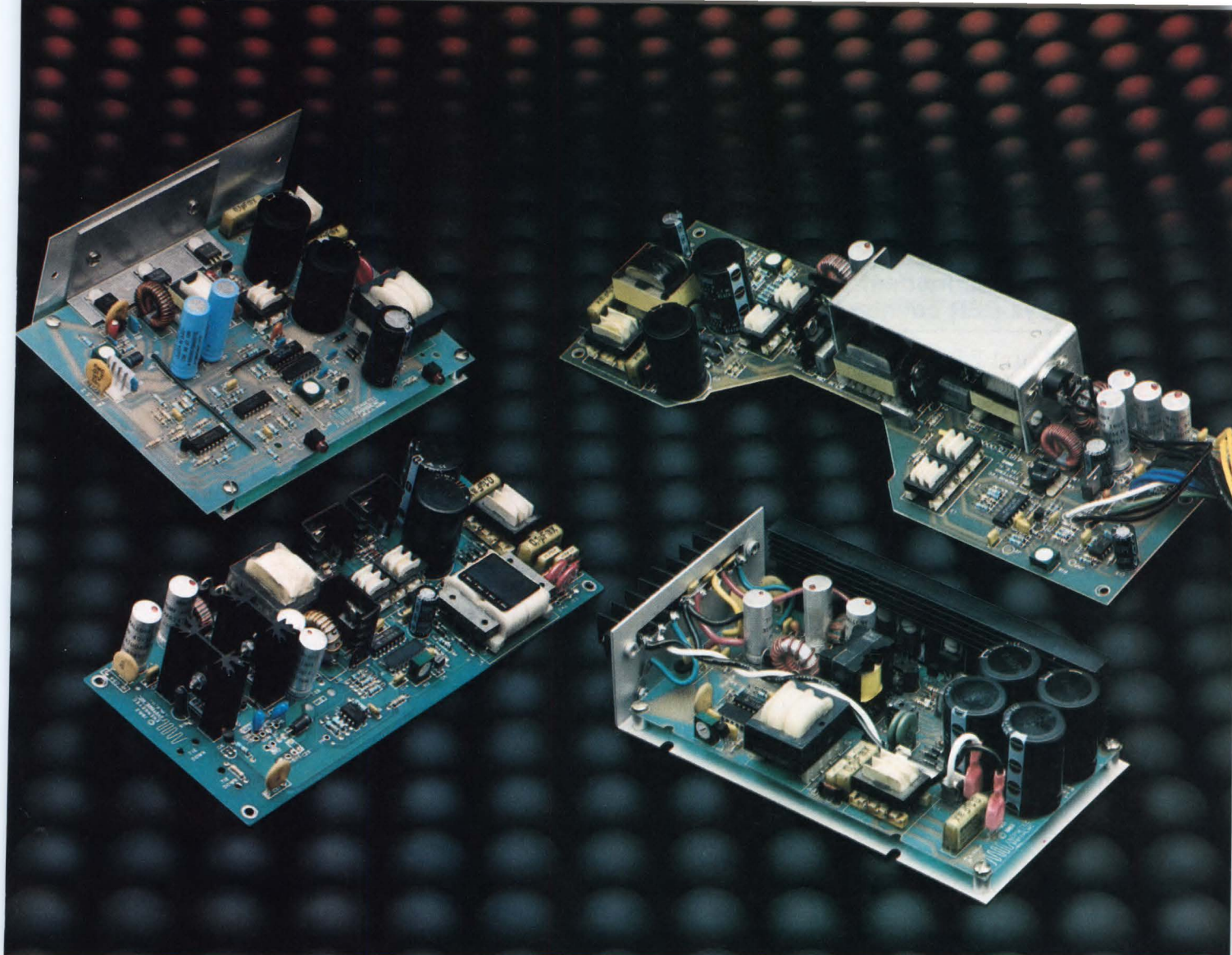
- Four Models to choose from
- LOWEST Cost in the Industry
- Programs all MMI 20 and 24 pin PALs
- PALASM Compiler Built-In to all Models
- All Programming via Boolean Equations
- Complete FUNCTION Test of Your PALs
- Works with Your Computer or "Stands Alone"



3201 North Hwy. 67 Suite H, Mesquite, Texas 75150 • (214) 270-4135 • Telex: 203941

*PAL and PALASM are registered trademarks of Monolithic Memories, Inc.

CIRCLE 578



THE POWER OF TECHNOLOGY

ENERGETEC CUSTOM DESIGNS ARE THE COST-EFFECTIVE SOLUTION TO YOUR SWITCHING POWER SUPPLY NEEDS.

Now Energetec brings you the exact features you require in your switching power supplies – with custom designs as cost-effective as the standards you're now buying.

Our highly skilled design engineers will work directly with you to help determine the best features, specifications, and optimum topologies for your system. This means your Energetec switching power supplies are neither over- nor under-specified. You're paying only for the design features your application requires.

And with careful and specific consideration of your mechanical design, Energetec custom power supplies can actually decrease the assembly costs of your product.

Energetec incorporates extensive experience in 100 KHz FET tech-

nology to design custom switchers that meet your exact application. And, as a result of 100 KHz switching frequency, Energetec switchers are smaller and lighter to allow you greater design flexibility and more options. This same advanced technology provides greater operating efficiency, which eliminates excess system heat.

Energetec switchers can be designed to provide low leakage current, elevated temperature requirements, extended hold-up times, custom configurations – and any other features required for your specific application.

Such features incorporated into Energetec custom designs have proven reliable in a wide variety of industries, including medical, industrial controls, computer systems, and

portable instrument applications.

With in-house capabilities for P.C.B. and mechanical prototyping, Energetec evaluation units can be designed and available for you in as *little as two weeks!*

In addition to custom designs, Energetec offers a full line of standard switchers that offer maximum reliability for a variety of applications.

For more information on Energetec custom capabilities and standard switching power supplies, contact Energetec Systems, Inc., 130 E. St. Charles Rd., Carol Stream, IL 60188. Phone (312) 653-1920.

 **ENERGETEC**
SYSTEMS, INC.

COMMUNICATIONS

Fiber-optic modem employs BER counter

The Model FTS-1 is a T.1 fiber-optic modem with an integral bit-error-rate counter, which monitors sys-

tem performance and indicates when it exceeds a BER of $10E-6$. In addition, the modem extracts the clock information from the data stream and uses it to retiming the incoming data. Loss of

the input signal causes the FTS-1 to substitute an internally generated clock and transmit an all-ones sequence to the remote site for maintaining continuity in a cascaded long-span line. At the same time, it generates an alarm at both the local terminal and at the far end. A pair of these modems with interconnecting cables transmits 1.544 Mbits/s at a distance of up to 5 miles.

California Data Link Inc., 45 Granada Court, Portola Valley, Calif. 94025; (415) 851-3459.

CIRCLE 329

KLIK-KEY+™

(COST-)

Cut costs with Klik-Key+: Shin-Etsu Polymer's new process of imprinting legends on conductive rubber switches.

The Klik-Key+ process chemically bonds the legend's image onto the key's silicone surface. This process equals diffusion printing in quality, and surpasses it in wear, but takes a third off your tooling costs. And half off your unit cost.

Klik-Key+ gives you a high-resolution image that enhances your switch's appearance. The imprinting process also adds a protective finish that extends the life of your rubber key tops.

Learn how you can cut the cost of diffusion printing with Klik-Key+. Call us today at (408) 947-0311. Write SP America, 1181 N. Fourth Street, San Jose, CA 95112.



 **Shin-Etsu Polymer**

CIRCLE 580

Unit links RS-232-C with Arcnet LAN

Compatible with the Arcnet baseband local area network, the Arcnet-Link is a self-contained unit with all the necessary connections to link one programmable RS-232-C serial port to one Arcnet node. The module comprises a COM 9026 network controller and a COM 9032 transceiver to perform complete protocol handling in a compact package. A 2k data-packet buffer offers four pages of packet storage, which may be dynamically defined for double-buffered transmitting and receiving functions. In addition, baud rates are switch-selectable from 1200 to 19,200. Units are available for 110/220-V, 60/50-Hz operation.

Standard Microsystems Corp., 35 Marcus Blvd., Hauppauge, N. Y. 11788; (516) 273-3100. \$995; stock.

CIRCLE 330

State-of-the-art design needs up-to-the-minute data.

Introducing VideoLogSM A videotex catalog for the electronics industry.

For the engineer, or other users of electronic components, equipment or services, finding the right products can be a tedious, costly and inconvenient process. Often, the end result of that process is a component that is obsolete. By the time a datasheet is published, its contents may already be out-of-date.

Now VideoLog, a new online service, can change all that. With VideoLog, you can log your personal computer into an up-to-the-minute database that brings information on 2,000 product categories and over 14,000 manufacturers and service organizations right to your screen. Search on up to 15 key parameters covering more than 500,000 types of semiconductors. Find functional equivalents and alternative sources. Review product data, including schematics and graphs in color.

You can locate a component instantly, review specifications, charts and diagrams. Using InfoGramSM, send an electronic message to a manufacturer requesting samples, data sheets, pricing or a phone call from the company. VideoLog also provides new product announcements and an online component reference library.

CIRCLE 581

See us at Wescon booths #3789-3791



The entire sequence takes only minutes, and assures you of up-to-the-minute, accurate information from the most complete component library ever assembled.

VideoLog is a valuable tool for everyone at the leading edge of today's electronics industry. Start using VideoLog today. Call our toll-free number, or use the coupon below for more details.

Call 1-800-VIDEOLOG

In Connecticut: 203-838-5100

Among the VideoLog catalog information providers are: AMD, AMI, Harris, Intel, Monolithic Memories, Inc., Mostek, Motorola, RCA, Signetics, Siliconix, Synertek, Texas Instruments, Xicor and Zilog.

© 1984, VideoLog Communications

2ED 10 84

☐ YES! Please send me more information about VideoLog.

Name: _____

Title: _____ Mail stop: _____

Company: _____

Address: _____

City: _____ State: _____ Zip: _____

Telephone: (_____) _____

Return to: VideoLog Communications
50 Washington Street, Norwalk, CT 06854

Hitachi's

The HD68450

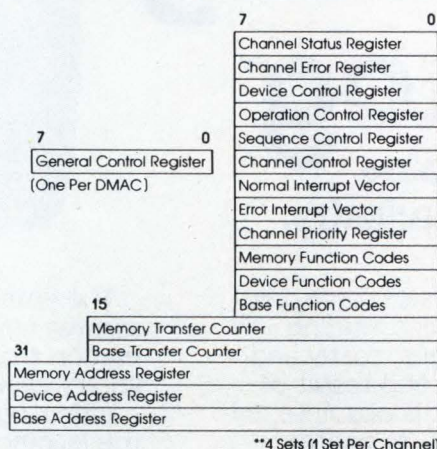
Providing high performance direct memory access capabilities in state-of-the-art systems... multiuser, multiprogramming general purpose computers, real time control systems, robotics, data communications, high-speed data acquisition.

By combining innovative new DMA protocols, the HD68450 Direct Memory Access Controller simplifies the design of high performance systems. This high level of integration opens the door for the design and construction of more sophisticated systems.

- Original Hitachi design, second sourced by Motorola
- Enables efficient and easy hardware and software design
- Memory-to-device, device-to-memory, and memory-to-memory transfers
- Continue mode and array chained, linked array chained operations
- Four independent channels with programmable priorities
- Handles byte, word, and longword data sizes
- External request mode and auto request mode
- Maximum transfer rate of 5 megabyte/sec.
- 64-pin package
- 8 and 10 MHz
- HD68000 bus compatible
- Interfaces directly with HD6800/HD68000/MOTOROLA MC68008*

This highly "intelligent" device can meet different data transfer requirements for your newest product design. For more information about the new Hitachi HD68450 DMA Controller, call your local Hitachi Representative or Distributor Sales Office.

Programming Model**

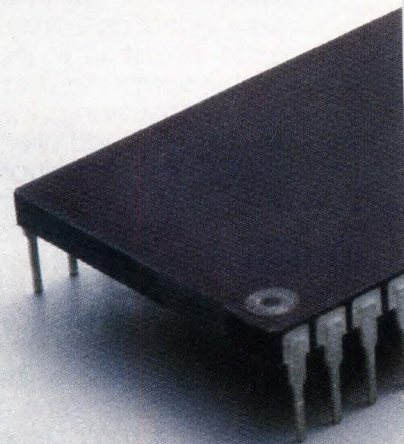


Hitachi also offers a complete line of memory, logic, 4 and 8-Bit Single Chip (CMOS 6301 Series), 8 and 16-Bit Microprocessor, and state-of-the-art peripherals (68450, 2-micron CMOS graphic chip and hard disk controller).

**CALL TOLL FREE
1-800-842-9000, EXT. 6809**

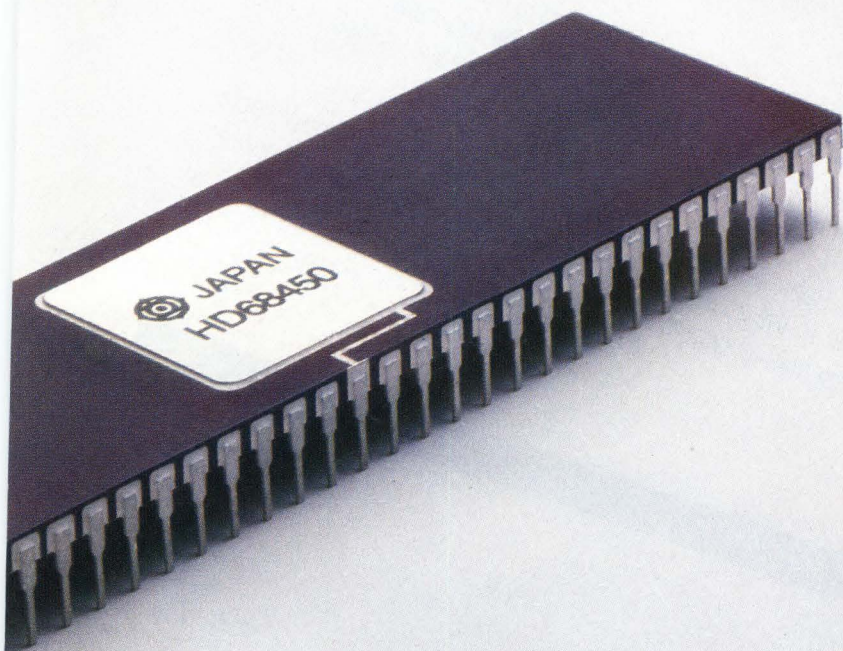
Use Hitachi's **Fast Action** toll-free number to obtain technical data, or to arrange for your Hitachi Representative to call about the Hitachi HD68450. Ask for literature number 708.

Hitachi America, Ltd.
Semiconductor and IC Sales
and Service Division
2210 O'Toole Avenue
San Jose, CA 95131
1-408/942-1500



*Registered trademark of Motorola Inc.

Super DMA Controller



HITACHI

A World Leader in Technology

MANUFACTURERS:

The Electronic Representatives Association is your resource for all the right reasons

- 1950 independent sales organizations, employing 9000 professional sales people, selling over \$15 billion of electronic products annually.
- Independent Manufacturers' Representatives in the electronics industry represent all product areas in the market place from semiconductors, computers, replacement parts and materials to electronic games, high fidelity components and professional products.
- Marketing Services are available specifically for manufacturers:

The LOCATOR — a directory listing close to 2000 independent manufacturers' representative companies throughout the U.S. and internationally.

Forms designed to guide you through the evaluation of a representative.

Contract Guidelines — a helpful "how to" sample contract to aid in the negotiating process.

- Lines Available Bulletin — a monthly mailing to our members providing a quick and effective method to get you into the rep network and your product into the marketplace, and free Lines Available listings at most major trade shows.
- The Electronic Representatives Association is a not-for-profit trade association dedicated to the advancement of the independent electronic manufacturers' representative system.



more than an association a philosophy

ELECTRONIC REPRESENTATIVES ASSOCIATION

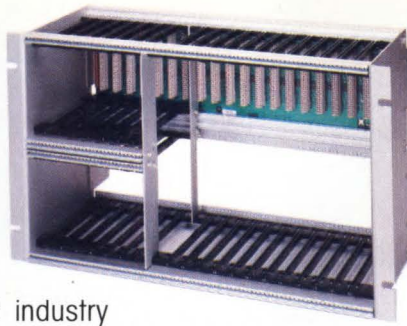
20 East Huron Street
Chicago, IL 60611
(312) 649-1333

Experience makes the difference

Every time you utilize a Scanbe VME card cage you're benefiting from over 20 years design experience in electronic hardware packaging. We've been in partnership with design engineers on everything from the early enclosures to our present industry standard T-Series cages, all metal card cages, Multibus™, STD-Bus and now VME. No other manufacturer offers a broader card cage line or has comparable experience in developing packaging systems.

Scanbe's VME card cages are available in off-the-shelf standard versions, or in full custom designs to perfectly match your requirements.

Scanbe's rugged and reliable VME Card Cages accept 3U and/or 6U size VME cards and feature: • 9 or 20 identified slots with or without backplanes • Steel



threaded inserts • Electrically conductive cage • Shipped fully assembled and tested • Backplanes fully meet VME specifications.

Why not find out the full story. Once you know the facts, you'll know there's no comparable VME card cage on the market today. Experience the Scanbe difference—call

or send for a free technical brochure today, or order now at: Outside California **(800) 227-0557**, inside California **(818) 579-2300**.

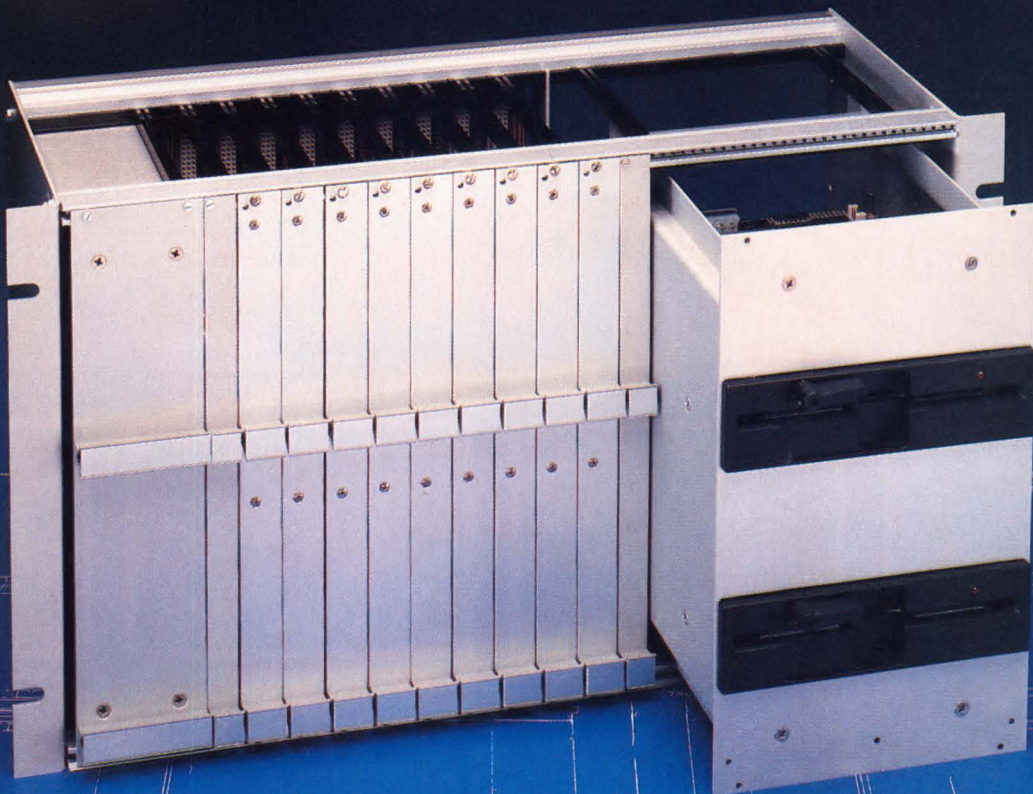
Scanbe, Division of Zero Corporation, 3445 Fletcher Avenue, El Monte, CA 91731.



LEADERS IN PACKAGING TECHNOLOGY

SEE US AT WESCON - BOOTH #2055-2057; 2059-2154

THIS VME CARD CAGE IS THE RESULT OF OVER 20 YEARS DESIGN EXPERIENCE.



CIRCLE 583

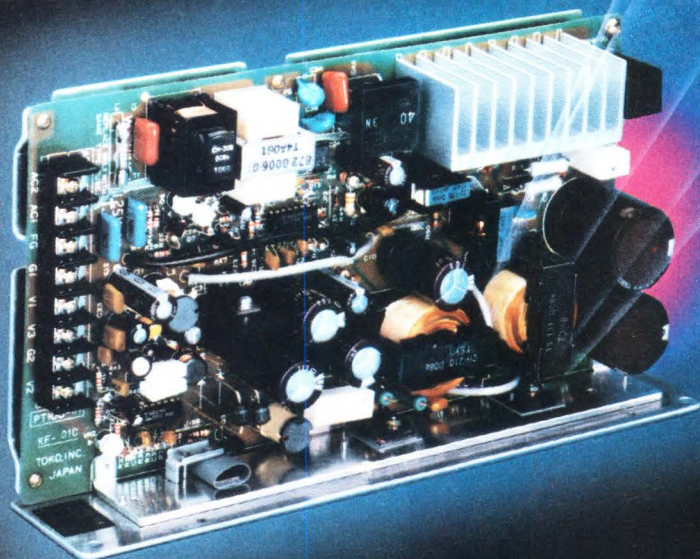
This unique transformer gives Toko switching power supplies the edge on performance

When you select a switching power supply, your product's reliability and performance are on the line. Will the sample you approve be typical of OEM production? It will if you evaluate Toko. We reinvented the transformer to assure a consistent level of performance not possible with conventional transformer designs.

Unlike ordinary wire-wound transformers, Toko transformers are based on a better idea — inductive copper strips interwound with Mylar* insulation over a high-efficiency iron core. This design** significantly tightens performance tolerance limits and improves transformer reliability. The chances of a shorted winding are greatly reduced and the probability of an open winding is virtually eliminated.

For even greater performance assurance and added value we've derated our component specifications by 20%. Such steps combine with a very high level of quality control to let us offer a *two-year warranty* — twice the industry average. All of these attributes, too, make Toko a better idea — not just a better power supply.

CIRCLE 584



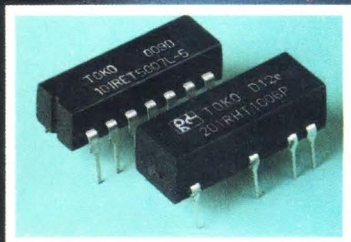
Toko also offers guaranteed delivery dates on standard supplies in virtually any quantity.

We've made major investments in reserve plant capacity to easily handle your largest OEM orders.

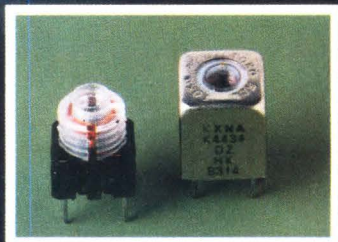
We also meet every major testing standard for safety and EMI/RFI suppression.

Contact us today for a copy of our new switching power supply catalog and more information on Toko.

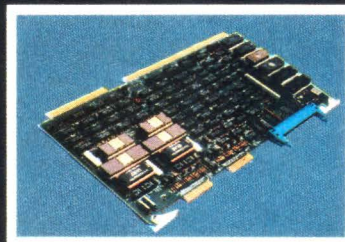
Toko America is the U.S. subsidiary of Toko, Inc., a large Japanese manufacturer of a broad range of high quality electronic products. Here's a sampling...



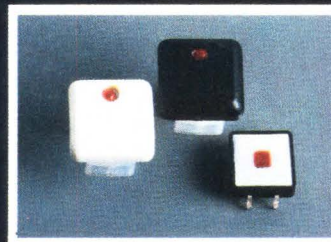
Delay Lines



Transformers and Inductors



Numerical Control Boards



Switches



TOKO AMERICA, INC.

5520 West Touhy Avenue Skokie, IL 60077 (312) 677-3640. Telex 72-4372 Facsimile: (312) 674-2910 (G III)
10050 N. Wolfe Road Cupertino, CA 95014 (408) 996-7575 Facsimile: (408) 996-7280 (G III)

TOKO... NOT JUST A BETTER POWER SUPPLY, A BETTER IDEA

* Reg TM Dupont

** Patents pending

"DESIGN YOUR OWN" HIGH RELIABILITY POWER SUPPLIES

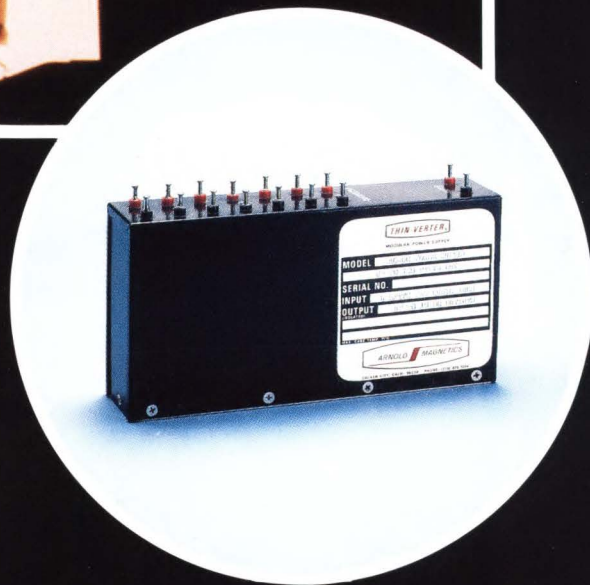


SELECT FROM PRE-DESIGNED MODULES TO MEET YOUR NEEDS!

- Miniature packages to 400 watts output
- 50% to 75% smaller than other switching supplies
- AC or DC inputs with 1 to 10 outputs
- Ultra Reliable: MIL-STD-810C, MIL-E-5400, MIL-E-16400

SOME CURRENT GOVERNMENT/MILITARY APPLICATIONS

- Airborne Command Center using 140 Arnold Models
- Mobile Microwave Communications Terminal
- Shipboard Missile Simulator
- Stinger Missile Test Set
- Electronic Countermeasures Console
- Ruggedized Military Computer
- Mobile Satellite Communications Vehicle
- Remote Air Traffic Control Terminal
- "Position Location and Strike System"
- Airborne Flight Data Recorder.



- Shipboard Missile Launch System
- Submarine Weapons Readiness Computer
- Satellite Positioning Link
- Pershing II Missile Test Set
- Microwave/RF Communications Equipment

ARNOLD MAGNETICS

ARNOLD MAGNETICS CORPORATION

11520 W. JEFFERSON BLVD. • CULVER CITY, CA 90230 • (213) 390-3537 • (213) 390-8837 • TWX 910-343-6468

One prime North American manufacturer of custom hybrid microcircuits isn't in the United States.

Garrett Manufacturing Limited, a top technology company in microcircuits, should be your Canadian participant in military programs.

We hold unquestioned expertise in manufacturing both thick and thin film custom hybrid microcircuits. Because over the years, we've established a proven record of effective design in dozens of U.S. aircraft, missile, and ground electronic systems programs. While helping fulfill your industrial benefits.

Because we are equipped with CAD and experienced in the latest and most sophisticated manufacturing techniques, we can typically go from Source Control Document to prototype in 16 weeks or less.

Which means the average turn-around time for your production circuit will be 20 to 26 weeks. But for time-critical projects, even faster arrangements are possible.

What's more, our CAD capabilities, documented production techniques and thorough testing of circuit designs sometimes allow us to suggest alternatives to designs we receive. Providing custom circuits which operate with greater reliability in the most extreme military environments.

We intend to maintain our leadership position among the free world's defence contractors. As stricter standards, like MIL-STD 1772, MIL-M-38510-F and MIL-STD 883C go into effect, GML will

meet or exceed them.

Our engineering and production personnel are available to meet with you now. At your facility. And since we're only hours away, it's our policy to be available throughout the entire project.

Send us general and source control specs on your next project. Our response time for quotes is usually under two weeks.

For further information, contact: Manager, Microcircuit Sales, Garrett Manufacturing, Ltd., 255 Attwell Drive, Rexdale, Ontario, Canada M9W5B8. (416) 675-1411.

GARRETT

GARRETT MANUFACTURING LIMITED

CIRCLE 201

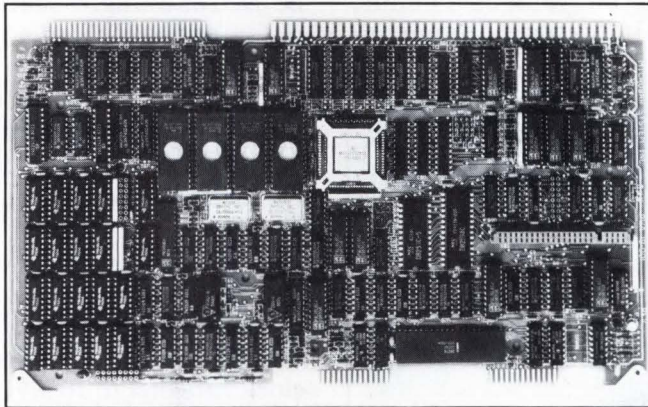


The Garrett Corporation
One of The Signal Companies



COMPUTER BOARDS

Multibus computer board transfers 32-bit blocks



A Multibus computer board with a 68000 microprocessor is the first to furnish a 32-bit data path between the CPU and main memory. The DBC68K2 single-board computer, from Microbar Systems, uses a proprietary version of the LBX extension, called LBX+.

The LBX extension provides an additional data path to memory in those cases where the main Multibus address and data bus is occupied with other data transfer activities such as I/O-processing tasks. It has been limited to 16-bit data transfers.

The LBX+ design, which is similar to a block-mode transfer, builds on this approach by holding the LBX data lines open for an additional clock period. This scheme allows two 16-bit blocks—a 32-bit data segment—to be transferred over the bus during each 400- μ s clock

cycle (with a 10-MHz clock).

Because the LBX+ extension provides an additional, separate data path, it complements the 68000, which has separate address and data lines, and speeds up data transfers. (The Multibus design, in contrast, ordinarily multiplexes addresses and data on the same lines). The consequence is a 35% increase in bus performance in burst-mode transfers.

The board also features an on-board RAM space that can accommodate 256-kbit chips; the memory is expandable from 512 kbytes to 2 Mbytes. The computer includes RS-232-C ports, an SBX port, and arbitration logic for multi-processor designs.

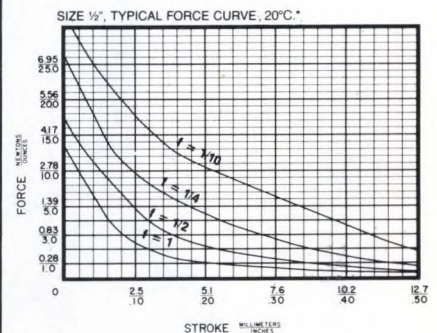
The single-unit price is \$3695, and delivery will begin in the first quarter of 1985.

Microbar Systems Inc., 785 Lucerne Drive, Sunnyvale, Calif. 94086; Debbie Fanucchi, (408) 720-9300.

CIRCLE 306

Stephan Ohr

Design in extraordinary life with NEW tubular solenoids



HOLDING FORCE 12 OZ.

*Based on average test results of 35 and 38 AWG.

New Ledex Series 20 tubular solenoids give your design extraordinary repeatability and reliability (100 million actuations typical). And, they cost far less than you might expect to pay for a long life solenoid. Sizes: 1/2" x 1", 3/4" x 1 1/2", and 1" x 2". Available with a variety of performance characteristics (push or pull, some off-the-shelf), with terminals or leads. Tell us about your custom application. Send for literature.

Ledex Inc.

P.O. Box 427

Vandalia, Ohio 45377-0427 U.S.A.

Phone: 513-898-3621

LEDEX®

helpful solenoid technology

CIRCLE 585

COMPUTER BOARDS

VMEbus CPUs also act as VMXbus master

Although VMEbus CPU boards are nothing new, ones that also can act as a VMXbus master most

definitely are. Two boards from Data Sud Systems do just that and, as a bonus, throw in National Semicon-

ductor's NS16081 floating-point processor. Either may be used as a single-board computer, as the CPU of a single-processor system, or as a master or a slave CPU in a multi-processor system.

The DSSECPUA1C double-Eurocard boards each use a 16-bit data bus and a 24-bit address bus and incorporate a 68000 (the DSSECPUA1-C) or a 68010 (the DSSECPUA1-C10) with a jumper-selectable clock rate of 4 to 16 MHz. Two optional 68451 memory management units may be piggybacked on each.

The 16081 performs arithmetic operations, delivering an execution time, measured from 68000 register to 68000 register, some 15 μ s for a 32-bit operation.

The boards come with 256 kbytes of dynamic RAM and 16 kbytes of static RAM for storage for a system monitor, plus two 28-pin JEDEC sockets for ROM or EPROM. On-board logic handles arbitration for RAM access.

The boards provide RS-232-C (V.24) serial communications up to 62.5 kbauds and have four independent 8-bit timers. Typical current drain from the 5-V line is 3.0 A for the 68000 version and 3.5 A for the 68010 board.

Data Sud Systems U.S. Inc., 2219 S. 48th St., Tempe, Ariz 85282; (602) 438-1492.

Data Sud Systèmes SA, 22 rue de Claret, BP 1067, 34007 Montpellier-Cedex, France; (67) 27-32-55; Telex: 490 425.

CIRCLE 310

ROEDERSTEIN

The Life-Savers.



The success and growth of your business depends on the quality of your finished product. For your assurance of a longer product life and quality construction, contact the one-stop source that can be a "Life-Saver" to your company — Roederstein Electronics.

Select from carbon, metal film or metal oxide fixed resistors or our wide variety of film, aluminum and tantalum capacitors. Our large in-house inventory can save you

space and time and meet the most demanding design requirements.

We've built a solid reputation for producing quality passive components for over 50 years.

For the right specifications, quality service and value — Design with Roederstein.

Roederstein Electronics
Your Source for
Quality Passive Components

ROEDERSTEIN ELECTRONICS, INCORPORATED

P.O. Box 5588 2100 West Front Street, Statesville, NC 28677 Phone: (704) 872-8101 TWX: 810-625-0786

When you have to test or burn-in pin arrays, SIP's or any other plug-in device package, reach into Textool for sockets.

What you'll find are over 25-years experience and the flexibility to deliver precisely the ZIP* socket you want. Whether

it's for test, burn-in or production.

For example, find a socket design to accept short leads, or up to 64 leads. Find a socket to accept different size packages, or hybrids on other than .100" centers, or lead diameters up to .040." Select from a

variety of socket materials, contact materials and ZIP handle configurations. And for odd ball packages we have in-line and staggered strips.

If we can't deliver to your specs right off the shelf, we'll customize a socket or design a new one just for you. And you can buy one to a hundred to as many as you need.

For details on how you can pull out a plum every time, get our "6,000 Designs"

brochure. Contact Textool Products, Electronic Products Div./3M, 225-1N-06, St. Paul, MN 55144. Or call **214-259-2676.**

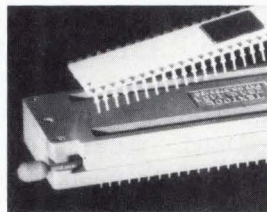
CIRCLE 587



In-depth Customer Engineering Department offers personal consultation and design evaluation.

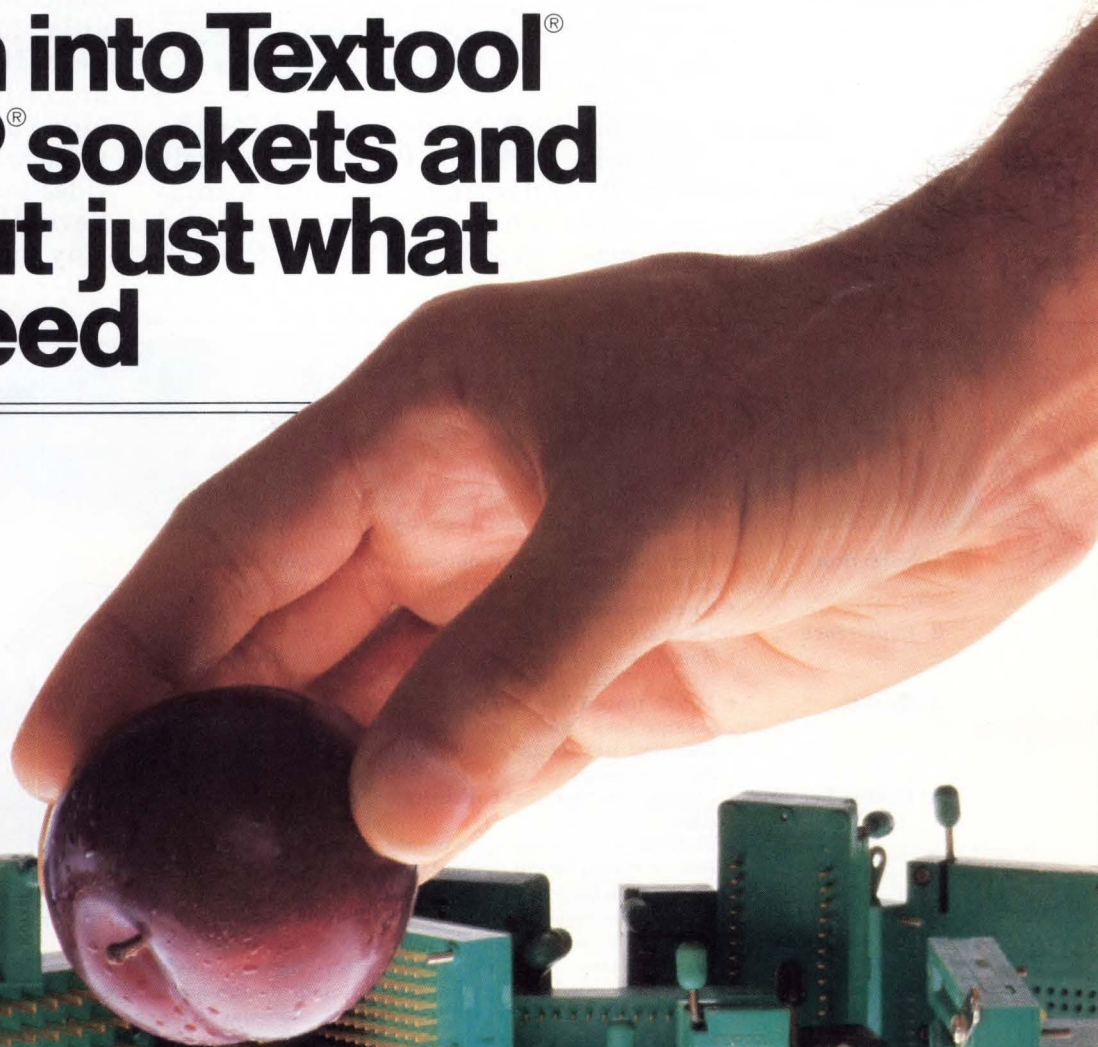


What you need may already exist in our library of 6,000 socket/carrier designs.



**Zero Insertion Pressure (ZIP) is a patented Textool innovation to eliminate mechanical damage to expensive IC's.*

Reach into Textool® for ZIP® sockets and pull out just what you need



What we don't have... we'll make

3M Hears You...

3M

COMPUTER BOARDS

Multibus controller handles packet switching

A Multibus-compatible front-end communications controller performs high-speed packet switching for such applications as point-to-point data transfers and complete networking. The board, which includes network-management firmware, supports HDLC, SDLC, ADCCP, and CCITT X.25 protocols. Designated the NIB 101/02, the controller operates at network speeds of 2 Mbits/s and supports 24-bit bus addressing. In addition, it can optionally support the T.1 carrier frequency of 1.544 Mbits/s. The controller em-

ploys an on-board CPU and 64 kbytes of memory, which includes 16 kbytes of dual-ported RAM. With 40 kbytes of temporary message storage, the NIB 101/02 permits up to 64 virtual circuits to be open at any one instant.

Destek Group, 830 E. Evelyn Ave., Sunnyvale, Calif. 94086; (408) 737-7211. \$1250; stock to 30 days. **CIRCLE 331**

Card combines video, text, and graphics

A plug-in board for the IBM PC simultaneously displays video with computer-generated text and graphics. Dubbed the PC-

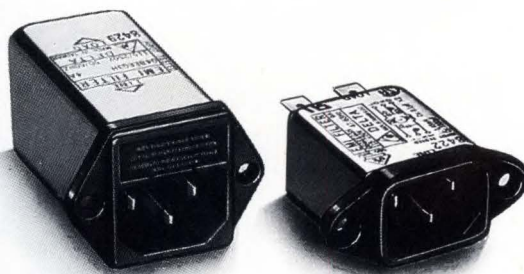
MicroKey System, it can be used with any off-the-shelf software that is currently available for the PC.

Offered in two configurations, Level I is an RGB-only system designed for use with a video disk player equipped with external sync and a Sony KX series or compatible monitor. Level II offers the added features of broadcast-quality NTSC composite video output in addition to the RGB capability. Level II permits overlaying not only the output of any video disk player, but any video tape player, still-frame video tape, or camera. Under Level II, the combined display can be broadcast or re-

DELTA EMI FILTERS

THE RIGHT CHOICE FOR DESIGN-IN

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Selection 2. Experience 3. Quality 4. Design Features 5. Availability 6. Price 7. New Designs | <ul style="list-style-type: none"> • Over 200 standard part numbers UL recognized and CSA certified. VDE approval on major types. • Custom designs welcome. • 14 years in high volume OEM manufacturing. • Rated as top quality supplier by IBM, DEC, WANG, RCA, ZENITH, PHILIPS, ITT, TELETYPE, etc. • 100% tested for hi-pot, leakage current and insertion loss before and after potting. • Average defect rate less than 200 PPM (Parts Per Million). • Superior mechanical construction, corrosion-proof case. • Molded core cover to separate toroid windings, non-rotating terminal insulators, both crimped and soldered connections. • Precision balance between choke windings, and use of low leakage current, high voltage and temperature stable capacitors provide excellent performance under actual operating conditions. • Stock to 6 weeks maximum for any standard model. • Stock at Hayward, CA and distributors throughout the U.S. • Very competitive pricing due to efficient design and automated mass production. • Continuous product developments are underway to meet changing market requirements. New products include: Power modules which integrate filtering, on/off power switch, voltage selector switch and fuse holder into one compact package, PCB mounted line filters, and AC line cords incorporating filter capabilities. |
|--|---|

**DELTA ELECTRONIC IND. CO., LTD.**

Reps: Simi Valley Ca 805-583-5124 Mission Viejo Ca 714-643-9486 Portland OR 503-297-8744 Salem OR 503-362-0717 Seattle WA 206-285-1300 Murray UT 801-261-4867 Aurora CO 303-360-9641 Scottsdale AZ 602-998-4850 Dallas TX 214-340-1300 Austin TX 512-459-1351 Houston TX 713-440-3888 Tulsa OK 918-664-0482 Hazelwood MO 314-839-0800 Cedar Rapids IA 319-365-8071 Mission KS 913-831-0555 Wichita KS 316-262-1020 Edina MN 612-925-5700 Chicago IL 312-631-1122 Indianapolis IN 317-849-4260 Huntsville AL 205-883-7893 Atlanta GA 404-257-0374 Melbourne FL 305-254-2554 Orlando FL 305-857-3760 Pompano Beach FL 305-942-0774 Woburn MA 617-938-8950 Webster NY 716-671-1000 Kenilworth NJ 201-272-9262 Wallingford CT 203-265-9900 McKean PA 814-476-1376 Baltimore MD 301-265-8500 Lynchburg VA 804-239-2626 Charlotte NC 704-525-2421 Greensboro NC 919-282-0740 Raleigh NC 919-782-2624 W. Columbia SC 803-256-0072 Greenville SC 803-288-8821 San Juan PR 809-790-1300

Dists: Mountain View CA 415-969-5420 San Jose CA 408-945-8400 Torrance CA 213-533-6005 Irvine CA 714-768-0855 Minneapolis MN 612-835-2322 Cedar Rapids IA 319-366-8733 Walled Lake MI 313-669-3710 Wellesley Hills MA 617-235-2545 Elmont NY 516-354-4813 McKean PA 814-476-7774



COMPUTER BOARDS

corded. Both systems operate in conjunction with IBM, Plantronics, or Tecmar color graphics cards.

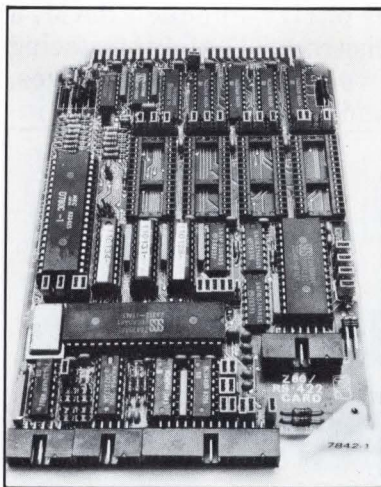
Video Associates Labs Inc., 3933 Steck Ave., Suite B-106, Austin, Texas 78759; (512) 346-5781. \$900 (Level I), \$1805 (Level II).

CIRCLE 332

Z80-based STD card has two RS-422 ports

A multifunction Z80A-based CPU card features two independent serial communications channels with multidrop capability. One channel provides RS-422 interface levels, while the other may be configured for either

RS-232-C or RS-422 interfacing. The STD bus-compatible board, designated the



7842, meets the requirements of process control and data acquisition applications for

long cable lengths, high noise immunity, and high data rates.

Operating at a maximum synchronous data-signaling rate of 500 kbits/s (4-MHz clock rate), the 7842 can transmit and receive data at distances of up to 4000 ft at 90 kbauds. The stand-alone system supports asynchronous, byte-synchronous (Bisync), and bit-synchronous (SDLC, HDLC, and CCITT X.25) protocols. It also has four JEDEC-standard 28-pin sockets to accommodate up to 128 kbytes of on-board memory.

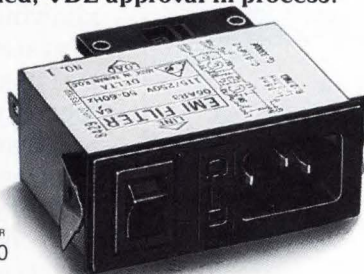
Pro-Log Corp., 2411 Garden Road, Monterey, Calif. 93940; (408) 372-4593. \$425.

CIRCLE 333

DELTA EMI FILTER

THE COST-EFFECTIVE SOLUTION FOR NOISE SUPPRESSION

We are pleased to introduce the new AR and AK series of filter modules, which incorporate IEC connector, fuse holder, power on/off switch and/or voltage selector switch plus filter all in one single, easy to install unit. The switches and capacitors used on the modules are VDE approved and a safety interlock prevents fuse removal with line plug inserted. These modules represent at least a one-third cost savings over individual components, plus additional assembly cost savings and space savings due to the compact design. All parts are UL recognized and CSA certified, VDE approval in process.



SEE US AT



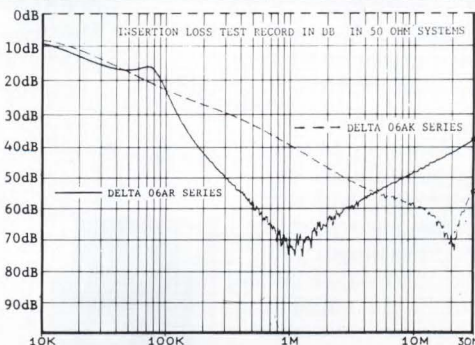
Wescon/84
Booth No. 3050



FOR MORE INFORMATION, PLEASE CONTACT:
DELTA ELECTRONIC IND. CO., LTD.

3401 INVESTMENT BLVD., SUITE #5, HAYWARD, CA 94545. TEL: 415-785-5231 TELEX: 4992342 DELTAITTHY
Headquarters:

11TH FL., LUCKY STAR BUILDING, NO. 112, CHUNG SHAN N. RD., SEC. 2, TAIPEI, TAIWAN, R.O.C.
TELEX: "26524 DELTATRO" TEL: (02) 511-3621, 521-3328 537-4585 ~ 7 FAX: (02) 521-3329



DELTAPART NO.	06AR1	06AR2	06AR3	06AR4	06AK1	06AK2	06AK3	06AK4
IEC CONNECTOR	△	△	△	△	△	△	△	△
FUSE HOLDER	△	△	△	△	△	△	△	△
POWER SWITCH		△	△	△		△	△	△
VOLTAGE SELECTOR SW.			△	△			△	△
DIMENSIONS (INCHES)								
L	2.38	2.38	2.59	2.59	2.38	2.38	2.59	2.59
W	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65
H	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14

D suffix to part numbers (06AR2, 06AR3, 06AK2, 06AK3) to replace single pole ON/OFF power switch with double pole ON/OFF power switch (Fig. B & D).
PART NO 06AR2D 06AR3D 06AK2D 06AK3D Current rating: 4A @ 250VAC

CIRCLE 588

COMPUTER BOARDS

J11-based SBC offers PDP-11/70 performance

Based on the J11 16-bit CPU chip, the Cobra/16 single-board computer is a full function system with the

computing power of a PDP-11/70. In addition to the J11, the module includes 1 Mbyte of parity-checked RAM, a disk controller for interfacing two SMD-type disk drives, and a tape controller for in-

terfacing two QIC-02-compatible 1/4-in. streaming tape drives. It also has a 32-port serial multiplexer.

An integral DMA facility handles high-speed data transfers between all system components. The Cobra/16 runs standard DEC operating systems, including RT-11, RSX-11M, and RSTS/E. The board is offered in configurations for OEMs, systems integrators, and end-users.

General Robotics Corp., 57 N. Main St., Hartford, Wis. 53027; (414) 673-6800.

CIRCLE 334

Dripproof Lighted Display Pushbutton Switches

Stay Dry: Series 50 Dripproof Lighted Display Pushbutton Switches are designed for those problem installations that may be exposed to rain, open deck spray, condensation on the panel surface, or similar applications where moisture may be encountered. The display pushbutton's captive rubber seal, precisely seated in the switch body, effectively closes all possible paths that the moisture might follow into the switch or behind the panel surface. All units meet or exceed the requirements of MIL-S-22885 and MIL-STD-108E.

Wide Selection: Switches are available with choice of 2PDT or 4PDT circuitry, momentary or alternate switch action, and common or split lamp grounds. Switch and lamp terminations are available in solder, printed circuit, wire wrap, or crimp pin type. Four-lamp illuminated pushbutton displays offer choice of six colors, five display arrangements, and ten display types, including **hidden and visible messages** and **sunlight readable legends**. Matching switches and indicators provide look-alike appearance.

Easy Mounting: Multiple station matrix housings, available either with rear mount flanges or front mount dress bezel, require only a single panel cut-out. Single mount units have simple, secure sleeve mounting. Single plane wiring reduces installation time and costs.



Free Catalog: Get the latest word on dripproof switches...write today for Design Catalog GC-6/7. Fully illustrated catalog gives complete descriptions and specifications, as well as product design features and engineering data.

STACO SWITCH
1139 BAKER STREET • COSTA MESA, CALIF. 92626
(714) 549-3041 • TWX: 910/595-1507

CIRCLE 589

Processor board enhances IBM PC

The PCTurbo-186, a high-speed processor board that utilizes an 80186 microprocessor, speeds up the processing power of the IBM PC and runs concurrently with the PC's 8088 processor. The PCTurbo-186 is an economical solution to upgrading the PC's performance while retaining full IBM software-compatibility. Furthermore, the maximum memory space of the PC remains available since application programs are run in the memory of the PCTurbo-186. Built-in options allowing a total of 1.2 Mbytes of system RAM, which would normally take valuable memory space away from the application being run, are implemented in the host PC's memory.

Orchid Technology, 47790 Westinghouse Drive, Fremont, Calif. 94539; (415) 490-8586.

CIRCLE 335

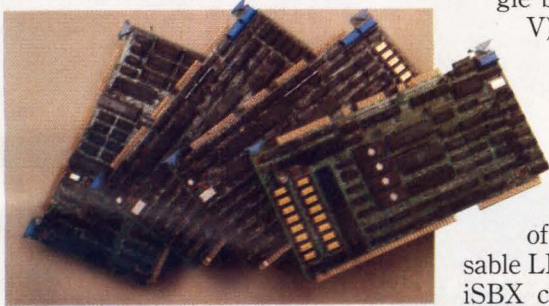
FOR THE MICROCOMPUTER OEM OR END-USER HEURIKON IS THE CHOICE

Make Heurikon your choice for Multibus™ microcomputers and system components.

For 12 years, Heurikon has supplied thousands of computers to help its customers find economical solutions for their microcomputer applications.

8-BIT MICROCOMPUTERS

MLZ-90A single board microcomputer with nine byte-wide memory sockets for use with RAM or ROM (AM9511 and floppy disk drive controller optional).

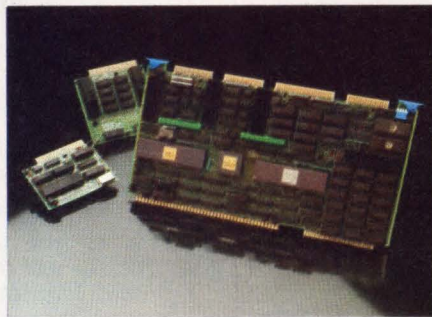


MLZ-91A single board CP/M™ system with on-card floppy disk drive controller, winchester interface, optional AM9511, streamer tape interface, two serial ports, one parallel port, 64K or 128K bytes RAM with parity, two EPROM sockets, and GPIB CONTROLLER.

MLZ-92A single board CP/M™ system with four serial ports on-card, floppy disk drive controller, winchester interface, optional AM9511, Centronics printer interface, 64K or 128K bytes of RAM with parity, and two EPROM sockets.

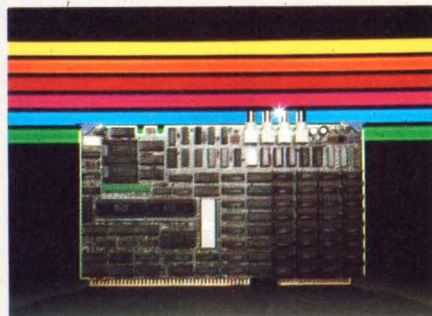
MLZ-93A single board CP/M™ system with 128K bytes of dual ported RAM, four EPROM sockets, floppy disk drive controller, optional AM9511 and powerful serial port features including SDLC and HDLC protocol support and modem controls.

16-BIT MICROCOMPUTERS



HK68™ powerful and versatile single board UNIX™ (System III or V) or CP/M68K™ system with 68000/68010 CPU (8Mhz or 10Mhz), MMU, quad channel DMA, four serial ports, 128K, 256K, 512K or 1M bytes of on-board RAM with parity, up to 32K bytes of on-board EPROM, user accessible LEDs and dip switches, and two iSBX connectors for I/O expansion. Heurikon can also supply a full line of iSBX I/O expansion modules including quad channel serial port module, floppy disk controller, A/D converter, bubble memory and many more.

GRAPHICS CONTROLLERS



MLZ-VDC intelligent 640 x 480 x 4 color graphics controller based on the NEC 7220 controller chip with on-

board Z-80 CPU, DMA controller, and user definable FIFO interface to Multibus™. Users may display up to 16 colors from a 4K palette. Up to 1024 x 1024 x 3 interlaced also available.

MICROCOMPUTER SYSTEMS



MINIBOX

Heurikon also provides completely integrated UNIX™ development systems with UNIX™ System III or System V including Berkeley enhancements. CP/M-80™, CP/M-68K™, and Regulus™ are also available.

Heurikon UNIX™ systems are available in four, six, and fourteen slot enclosures with 30MB, 65MB, 140MB or 280MB of winchester storage, a megabyte floppy, and optional *interactive* on-line streamer tape drive supporting 1-16 users.

HEURIKON

Microcomputers For Industry

3201 Latham Dr.
Madison, WI 53713
Telex 469532

Call Heurikon Direct

1 800 356-9602

In Wisconsin 1 608 271-8700

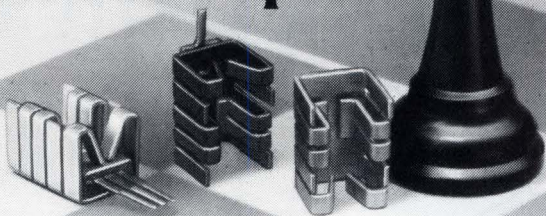
Z-80 is a trademark of Zilog Corp. Multibus and iSBX are trademarks of Intel Corp. UNIX is a trademark of Bell Lab. CP/M 68000 and CP/M-80 are trademarks of Digital Research. HK68 is a trademark of Heurikon Corp. Regulus is a trademark of Alcyon.

"Comdex Fall '84 Booth #C515"

CIRCLE 590

HEAT SINKS

Plug-in heat sinks save board space.



Just 1/2-in. wide, they're the slimmest plug-in heat sinks made for TO-220s. Series 5768 heat sinks save PC board space, and save labor. They quickly plug in without time-consuming fastening. Four spring-action clips assure the tightest possible fit between the TO-220 and heat sink for maximum heat dissipation.

Send for evaluation sample and new 76-page catalog.



AAVID ENGINEERING, INC.
30 Cook Court, Box 400
Laconia, New Hampshire 03247
(603) 524-4443

CIRCLE 615

MULTI-USE POWER SUPPLY FROM STOCK.



Check it out • Provides constant voltage/current
• Models up to 200 volts • Load regulates voltage to .01% line to .005% • Recovers within 100 μ secs
• Ripple < 500 μ volts • Mounts on a lab bench or rack (half size) • Has remote programming and sensing capability • Can operate in series or parallel • It's tremendously versatile.

For full details, prices and options on the **HW Series**, send for your free copy of our standard full-line power supply catalog.

Shipped from stock within one week.



3750 East Market Street
York, Pennsylvania 17402
(717) 757-4641 ; TLX 84-0432

CIRCLE 616

THE TROUBLE ELIMINATORS Potrans Trouble-free Transformers



We make UL-listed plug-in AC-to-DC and AC-to-AC transformers, both direct and indirect, regulated and unregulated. They can save your money: use one of our plug-in transformers, and you can get immediate UL approval for your product because the unit doesn't have to be retested with the transformer inside. That reduces space, heat, and leakage flux in your design. We also welcome your custom designs for new transformers. For Details please call or write to:

UL LISTED PLUG-IN CLASS 2 TRANSFORMER		
MODEL	OUTPUT VOLTAGE	OUTPUT CURRENT
WP350218	18V	0.1A
WP350312	12V	0.25A
WP350324	24V	0.1A
WP410412	12.6V	0.3A
WP410612	12V	0.5A
WP410614	14V	0.4A
WP410624	24V	0.25A
WP481012	12V	0.83A
WP481024	24V	0.42A
WP571616	16V	1.0A
WP571618	19V	0.84A
WP572012	12V	1.67A
WP572024	24V	0.83A
WP572408	8V	3.0A
WP572412	12V	2.0A
WP663021	21V	1.4A
WP663322	22V	1.5A
WP664012	12V	3.3A
WP664012	24V	1.67A

OPTIONAL CONSTRUCTION FEATURES SUFFIX SYSTEM
C: OUTPUT CENTER TAPPED
G: 3 PRONG INPUT PLUG
H: DISCHARGE RESISTOR BUILT BETWEEN INPUT-OUTPUT
OUTPUT CORD OR SCREW TERMINAL

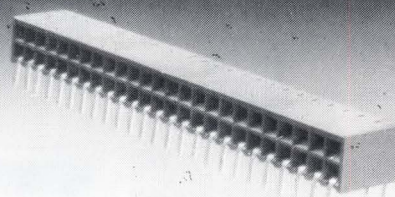


POTRANS ELECTRICAL CORP., LTD.

OFFICE: 5 FL-2 NO. 2 LANE 199, HSIN-YI RD. SEC. 4, TAIPEI, TAIWAN, 106
TEL: (02) 701-6769, 707-7296, 707-8253 TELEX: 10905 POTRANS
U.S.A. LIAISON OFFICE: 550 EAST PACIFIC COAST HIGHWAY SUITE 211,
SEAL BEACH CALIF. 90740 U.S.A.
TEL: (213) 596-4456 TELEX: 656458 POTRANS USA

CIRCLE 617

Die-Tech's new box connector gives you the highest reliability and cost savings.



Die-Tech's RE-LI-ON connectors provide superior mechanical and electrical interconnection. Surface or through - board mounting, these durable receptacles mate with .025 sq. pins.

The RE-LI-ON connector provides the versatility of a box connector with the accuracy and flexibility of a separate beryllium copper contact spring. Available in single or double row on .100 centers, in 3 thru 33 positions.

For more information on Die-Tech's RE-LI-ON connectors, write or call: Die-Tech, Inc., R.D. #1, Sipe Road, Box 518A, York Haven, PA 17370, (717) 938-6771.

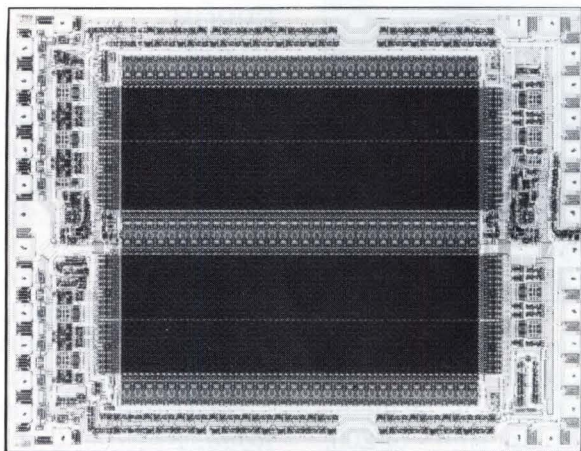


Engineered productivity.

CIRCLE 618

DIGITAL ICs

Fast CMOS FIFO registers are the deepest yet



The largest first-in, first-out register yet fabricated in CMOS, Integrated Device Technology's IDT7202 can hold up to 1024 9-bit words. A cousin, the IDT7201, holds 512 words and is a CMOS equivalent of Mos-tek's NMOS MK4501.

The commercial versions of the FIFOs, which can be read from or written to asynchronously and simultaneously, offer access times of 50, 80, or 120 ns maximum; military versions add a 5-ns margin. These times are faster than those of any other MOS FIFO and come close to those of bipolar parts. Read and write cycle times are slightly slower—65, 100, and 140 ns for the commercial versions.

To get such high speed, the chips trade off the very low power expected but still obtain operating current levels

well below NMOS or bipolar FIFOs: The maximum supply current is 80 mA for the commercial and 100 mA for the military units. On standby, the current drain drops to just 8 mA and 15 mA, respectively, and the chips offer a power-down mode that cuts the supply current to 0.5 or 0.9 mA, respectively.

The FIFOs are housed in a 28-pin ceramic DIP or a 32-contact leadless chip carrier. They include control signals to indicate when the register is half full, full, or empty, plus two expansion control signals.

In a DIP, 120-ns commercial versions of the IDT7202 and IDT7201 cost \$48 and \$86, respectively. Delivery of samples is from stock.

Integrated Devices Technology Inc., 3236 Scott Blvd., Santa Clara, Calif. 95051; Frank Toth, (408) 727-6116.

CIRCLE 311

Dave Bursky

41A DIGITAL DELAY LINE MACHINE INSERTABLE

All ESAN Delay Lines offer high quality and low cost. Send for catalogs and free sample.

ESAN USA, INC.



SPECIAL DESIGNS ON REQUEST

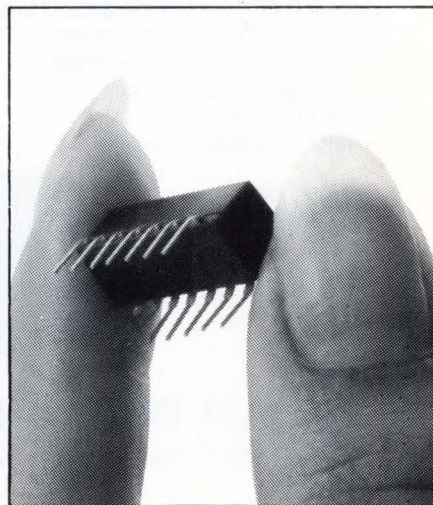
Delay Lines Available From ESAN USA, INC.

- 41A-5 tap, Digital Delay Line, DIP, Automatic Insertion
- 31A-5 tap, Digital Delay Line, DIP Compatible
- 50A-10 tap, Digital Delay Line, DIP Compatible
- 10A, 11A, 12A - Passive Delay Line, DIP, Automatic Insertion
- 20A, 21A, 22A - Passive Delay Line, SIP Package

Sole U.S. Agent



TRI-MAG, Inc.
8210 W. Doe Ave.
P.O. Box 4079
Visalia, CA 93278-9990
(209) 651-2222



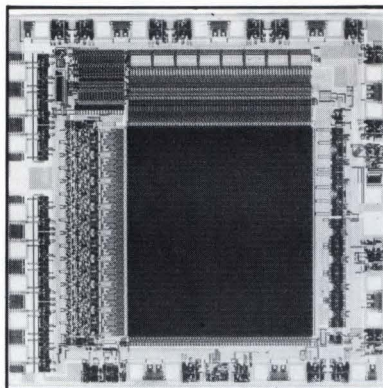
CIRCLE 591

DIGITAL ICs

64k EPROM draws little current

With an active current drain of just 10 mA when operated at 4 MHz and used with CMOS I/O lines, a 64-kbit CMOS EPROM cuts that figure a hundredfold when in its standby mode. The 27C64 is one of the lowest-power EPROMs of that density.

The chip, the first CMOS nonvolatile memory from Intel, uses a version of the company's CHMOS II-E process, which combines an epitaxial layer (to provide latch-up immunity) and 2- μ m feature sizes. The use of 2- μ m technology keeps the pro-



gramming voltage low—just 12.5 V is needed.

Three versions of the memory, with access times of 200, 250, and 300 ns, are available. With an organization of 8096

by 8 bits, the EPROM can drop into system sockets already using 64-kbit NMOS EPROMs.

Intended for operation from a 5-V supply, the chip can handle voltage margins of up to $\pm 10\%$. (If non-CMOS interfaces are used, the active supply current increases from 10 to 20 mA.)

The 200-ns version of the memory costs \$25.60 in lots of 10,000 units. All versions are available from stock.

Intel Corp., 151 Blue Ravine Road, Folsom, Calif. 95630; Bruce McCormick, (916) 351-2750.

CIRCLE 305

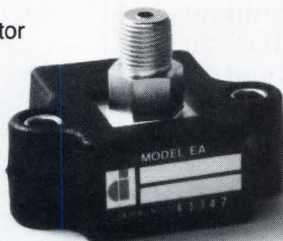
PRESSURE TRANSDUCERS

SUPERIOR QUALITY
AT OEM PRICES

Model EA Pressure Transducers feature a unique design that puts corrosion-resistant stainless steel in contact with your pressure media. Our EA transducers have high overload capabilities and proven long-term zero and span stability. You get pressure transducers that are interchangeable and fully calibrated and temperature compensated.

- Ranges: 0-6 to 0-5,000 PSIG
- Voltage output: 5V span
- Non linearity: 0.5%
- Internal voltage regulator

Call us today at
(617) 861-7450.



DATA INSTRUMENTS
4 Hartwell Place, Lexington, MA 02173 USA

CIRCLE 592

DC OVERVOLTAGE PROTECTORS

FOR MILITARY APPLICATIONS
REQUIRING JANTX SPECIFICATIONS



LVC-M

6-36V
55-235A

The **LVC-M** series are heavy duty overvoltage protectors that sense when a DC overvoltage is occurring and protects your sensitive circuitry within microseconds.

When an overvoltage occurs, the **LVC-M** series switches from an "open" circuit to a virtual "short" circuit, thus protecting IC's, microprocessors, etc. Recovery is automatic when power is momentarily removed.

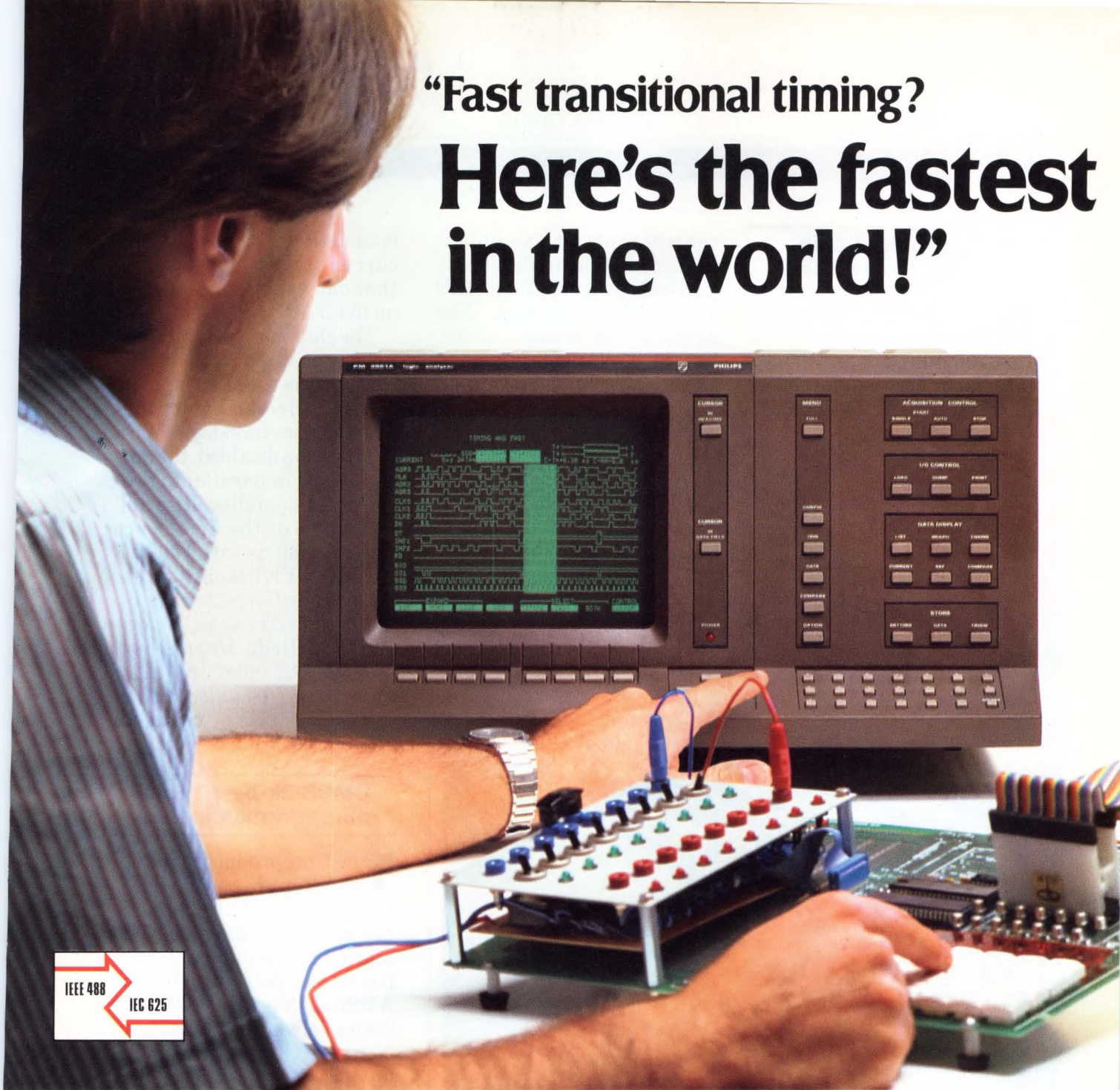
For more information, call
(516) 586-5125 or write to
the address below.

MCG

ELECTRONICS, INC.
12 Burt Drive
Deer Park, N.Y. 11729
(516) 586-5125 • Telex 645518

CIRCLE 593

**"Fast transitional timing?
Here's the fastest
in the world!"**



"Philips' PM 3551A is simply the number one Logic Analyzer."

"It speaks for itself. Fastest transitional timing analyzer in the world!"

At 300 MHz you can pinpoint a glitch right down to 4 ns or even less, in real time. Transitional timing for the ideal combination of a big memory and the highest timing resolution.

Simultaneous state and timing analysis. Infinite trigger memory. Displays up to 16

channels simultaneously; touch a button to disassemble any 8 or 16-bit microprocessor. Unmatchable triggering - can even trigger on the first false step in a polling sequence. Plus a simple, powerful menu system that puts you fully in charge - right from the first day.

By all means talk to others - the PM3551A speaks for itself! Want to hear it? Contact...

... your local Philips Sales organization or Philips S&I, T&M Dept., TQ III-4- 62, 5600 MD Eindhoven, The Netherlands.

In the US call: 800-631-7172, except Hawaii, Alaska and NJ. In NJ call collect (201) 529-3800 or write to 85 McKee Drive, Mahwah, NJ 07430.

Germany (0561) 50 15 11

Great Britain 0223-35 88 66

France 01-830 11 11."



**Test & Measuring
Instruments**

CIRCLE 594

PHILIPS

DIGITAL ICs

Dual-output chip drives power FETs

Designed with a high-speed Schottky process, the UC3706 dual-output driver interfaces between low-level

control functions and high-power switching devices—particularly power MOSFETs and bipolar transistors. The device accepts a single-ended, low-current digital input of either polarity and processes

it to activate a pair of high-current totem-pole outputs that can each source or sink up to 1.5 A.

The chip can optionally perform a push-pull conversion through the use of an internal flip-flop driven by double-pulse-suppression logic. With the flip-flop disabled, the outputs work in parallel to provide 3-A capability. Rise and fall times of the driver are typically 40 ns into 1000 pF (typical of FET capacitance).

Unitrode Corp., Linear Integrated Circuits, 7 Continental Blvd., Merrimack, N.H. 03054; (603) 424-2410. From \$2.85 (100 units); stock.

CIRCLE 336

CMOS 2k-by-8 PROM outperforms bipolars

The first product in a family of high-speed CMOS PROMs, the 7C245 2k-by-8-bit registered device is a higher-performance, lower-power second source for the AM27S45 bipolar PROM. The device delivers a setup time of 35 ns, with 15-ns clock-to-output times and full 10% power supply tolerances. Furthermore, the 7C245 draws only 90 mA over the full 0° to 70°C temperature range.

Also introduced are two 2k-by-8-bit nonregistered PROMs. The 7C291 and 7C292 provide address access times of 35 ns, with 20-ns chip-select access times over the temperature range of 0° to 70°C.

Cypress Semiconductor Corp., 3901 N. First St., San Jose, Calif. 95134; (408) 493-2600. Stock. CIRCLE 337

For Those Who Think Ahead

INTELLIGENT PROGRAMMER

PKW 1000



FX-1

2716, 2732, 2732A, 2764, 2764A, 27128, 27128A, 27256, 27C256,

FX-2

8748, 8741A, 8749H, 8742, 8748H, 8755A,

FX-3

8751, 8751H,

FX-4

2716, 2732, 2732A,

FX-5

2764, 2764A, 27128, 27128A, 27256, 27C256,

US\$1,600(PKW-1000 incl. FX-1)

EPROMs and 1 chip CPU's are programmed using simple, inexpensive plug in adapters.

The PKW-1000 from AVAL is the intelligent programmer for intelligent programmers. Why? Because it's guaranteed never to become obsolete. Compact and portable, the PKW-1000 is designed to be current and future device compatible. All you do is change the system PROM — in seconds. You'll never need to replace the hardware — ever.

- Large-capacity 64K-byte buffer RAM
- Wide range of check functions
- Helpful LCD display functions
- High-speed RC-232C serial (19,200 BPS) and Centronics parallel interfaces
- Numerous programming tape formats
- High-speed algorithms [50ms. pulse/Intel (I,II)/Fujitsu]
- Battery back-up

Manufactured by
AVAL CORPORATION

EUROPE
AVAL CORPORATION OF IRELAND LTD.

U.S.A.
OKAYA(U.S.A), INC.

Shinjuku NS Bldg., 4-1, Nishi-Shinjuku 2-chome, Shinjuku-ku, Tokyo, Japan 160
Tel: 03-344-2001 Tlx: 2323387 AVAL J

11 Deansgrange Ind. Est., Kill Lane, Deansgrange, Co. Dublin, Ireland
Tel: (01)850533 Tlx: 90144 AVAL EI

ECD INDUSTRIES, INC. Tel: 213-820-3009

CIRCLE 595

NEW PRODUCTS

DIGITAL ICs

CMOS EPROM offers high density, low power

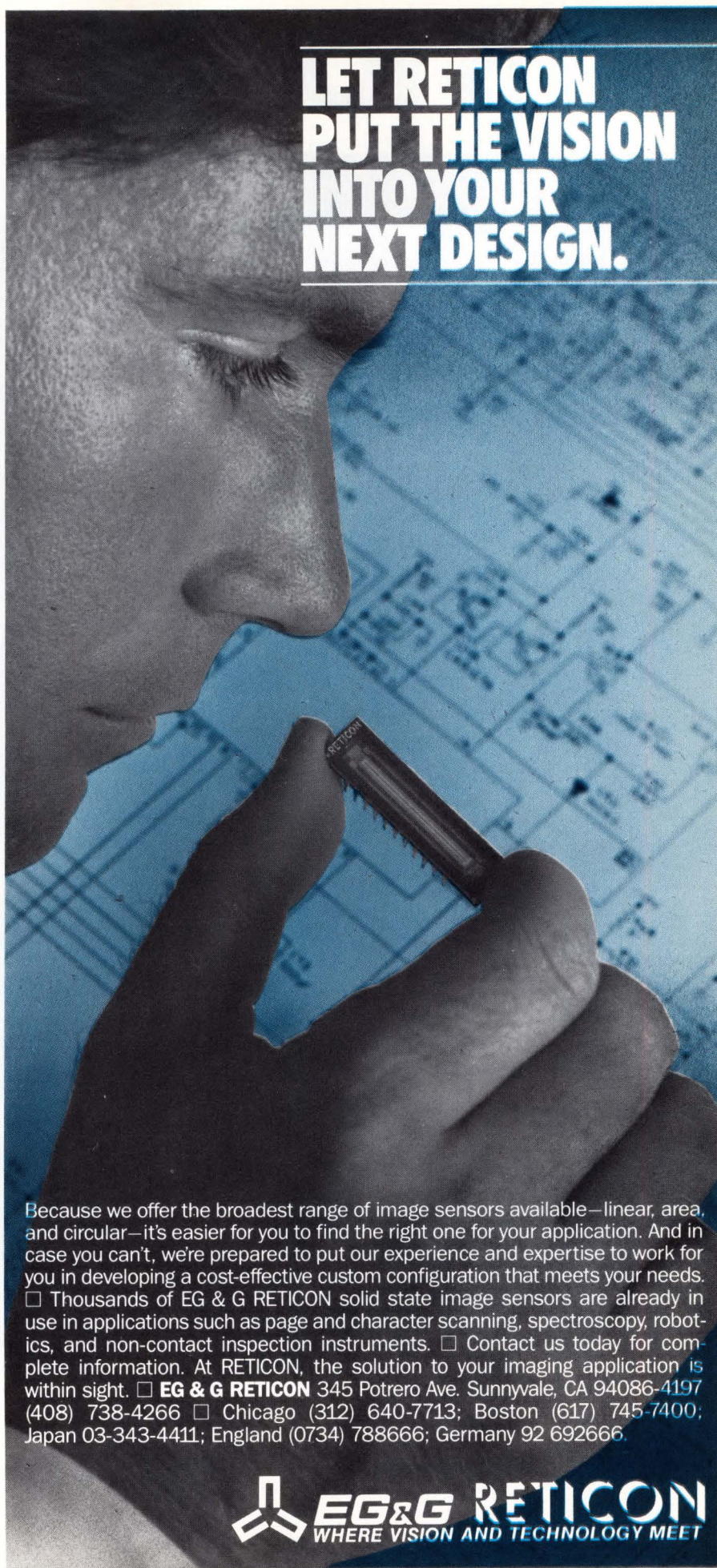


Featuring high performance and low power consumption, a 256k CMOS EPROM allows engineers to design smaller, lighter, and more power-efficient end products. Versions of the MBM27C256 EPROM are available with access times of 250 and 300 ns. With a 4-MHz clock (250-ns access), the CMOS device dissipates 158 mW—30 mA of active current from a single 5-V ($\pm 5\%$) power supply. In standby mode, power dissipation is only 0.53 mW (100- μ A standby current). Furthermore, since power dissipation drops with lower clock frequencies, the power needed by the MBM27C256 is even lower in applications where high-speed operation is not required. At 1 MHz, active current is 10 mA and standby current is only 1 mA. The EPROM is offered in either a 28-pin DIP or a 32-contact leadless chip carrier.

Fujitsu Microelectronics, Marketing Division, 3320 Scott Blvd., Santa Clara, Calif. 95051; (408) 727-1700. \$130 (250-ns access), \$115 (300-ns access) (100 units).

CIRCLE 338

LET RETICON PUT THE VISION INTO YOUR NEXT DESIGN.



Because we offer the broadest range of image sensors available—linear, area, and circular—it's easier for you to find the right one for your application. And in case you can't, we're prepared to put our experience and expertise to work for you in developing a cost-effective custom configuration that meets your needs. ☐ Thousands of EG & G RETICON solid state image sensors are already in use in applications such as page and character scanning, spectroscopy, robotics, and non-contact inspection instruments. ☐ Contact us today for complete information. At RETICON, the solution to your imaging application is within sight. ☐ **EG & G RETICON** 345 Potrero Ave. Sunnyvale, CA 94086-4197 (408) 738-4266 ☐ Chicago (312) 640-7713; Boston (617) 745-7400; Japan 03-343-4411; England (0734) 788666; Germany 92 692666.

 **EG&G RETICON**
WHERE VISION AND TECHNOLOGY MEET

CIRCLE 596

IS YOUR CHIP MAKER

Am8052
Most advanced
CRT Controller.

Am7910
First multi-spec
single chip modem.

Am29116
Fastest 16-bit
microprocessor.

Am29540
First bipolar
LSI FFT processor.

Am7990/91A
First LSI
Ethernet chip set.

Am29818
First IC
with diagnostics.

Am7901
First programmable
CODEC/Filter.

Am27543A
Fastest 32K
bipolar PROM.

Am9150
First clearable
static RAM.

Am27512
First
512K EPROM.

PAL is a registered trademark of and is used under license from Monolithic Memories, Inc.,
© Advanced Micro Devices 1984.

AS BRIGHT AS YOU ARE?



Am29516A
Fastest 16-bit
multiplier.

AmPAL22V10
First LSI PAL
device.

Am6112
Fastest monolithic
12-bit A/D.

Am7990/91A
First LSI
Ethernet chip set.

You're doing everything you can to stay ahead of the competition. Shouldn't your IC company do the same?

We think so.

In 1983 we spent a record-breaking 18.7% of sales on research and development. That's more than any other major IC company.

And that's why 40% of our total sales come from products that were invented here.

Our Am8052 CRT controller lets you squeeze every last drop of performance out of a video tube.

And our Am7910 is the only modem you can program for any major telephone system anywhere in the world.

We make the first perfectly matched VLSI Ethernet chip set and the only complete kit solution to super high speed digital signal processing.

We make the world's first 512K EPROM and the world's fastest microprocessor.

We're even an innovator when it comes to quality.

While other guarantees run on and on,

The International Standard of Quality guarantees a 0.1% AQL on all electrical parameters, AC and DC, over the entire operating range.

INT-STD-1000

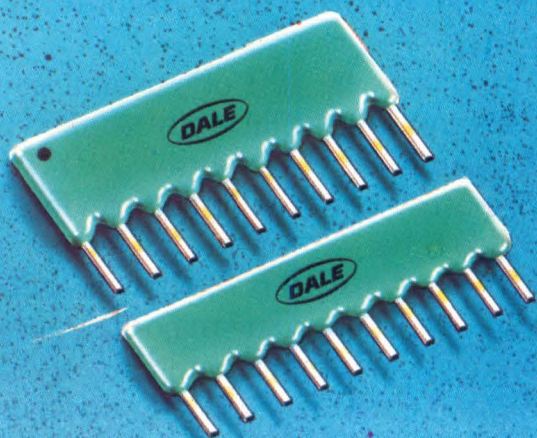
ours is short and sweet.

So, if you've got a product you want to really shine, call us. We can put you as far ahead of the competition as we are.

Advanced Micro Devices

901 Thompson Place, P.O. Box 3453, Sunnyvale, CA 94088
(408) 749-5000, outside California, call toll free (800) 538-8450, ext. 5000.

Solutions



**Networks that
will improve
your cost.**

Dale's CSC.

Low cost, plus the assured quality and delivery of Dale's ZIP program makes CSC thick film resistor networks tough to beat. These epoxy conformal coated networks are available in .195", .250" and .350" aboveboard heights with 3 through 11 resistors (1 pin common) and 2 through 6 isolated resistors. Tolerances of 1%, 2%, 5%, 10% and 20% are available in a range from 10 ohms to 3.3 megohms. Evaluate the CSC...as part of Dale's ZIP program. It's guaranteed to give you problem-free delivery and quality. Contact: Dale Electronics, Inc., Box 26950, El Paso, TX 79926.

For more details, call: **915-592-3253**

See us at Electronica, Booth 14-C-26.

CIRCLE 651



**You can
see the
advantages.**

Dale Displays.

Bright. Legible. Versatile. We're ready to help you use the advantages of plasma panel displays wherever you need to convey information. Our new bar graph models handle a wide range of control and indication needs. Each has dual linear graphs with 201 or 101 elements, resolution down to 1/2% and requires a minimum of drive circuits. In addition, standard segmented and dot matrix styles with up to 256 characters are available with complete drive electronics. To get more details contact: Dale Electronics, Inc., 2064 12th Ave., Columbus, NE 68601

For complete information: **402-564-3131**

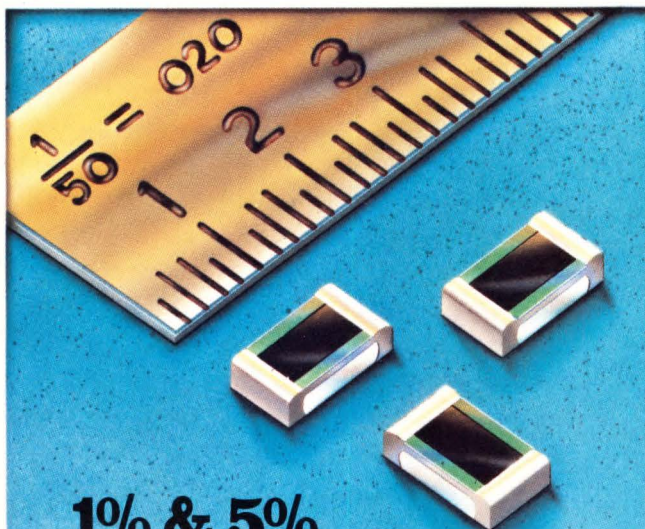
See us at Electronica, Booth 14-C-26.

CIRCLE 652

Dale makes your basics better.



from Dale



1% & 5% Thick Film Chip Resistors.

Dale's CRCW.

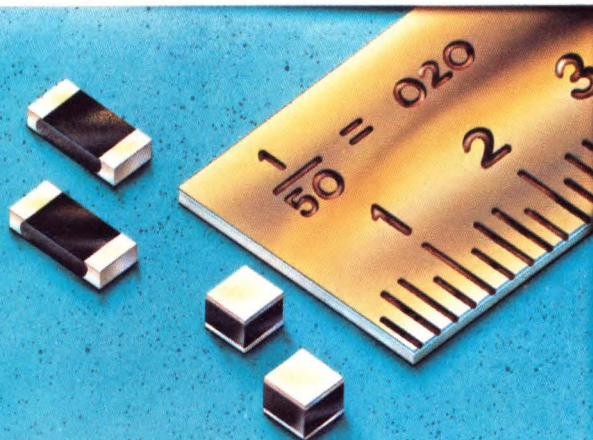
Dale CRCW 1% and 5% chips offer design flexibility for meeting precision and general purpose requirements in surface mount applications. CRCW 1% styles provide a rating of 1/8 watt from 20 to 300K ohms with a TC of ± 100 PPM/ $^{\circ}$ C. CRCW 5% styles provide 1/8 watt from 10 ohms to 2.2 megohms with a TC of ± 200 PPM/ $^{\circ}$ C. All CRCW styles have wraparound terminations and utilize the standard .126" x .063" size which is compatible with automatic placement equipment.

Contact: Dale Electronics, Inc.,
2300 Riverside Blvd., Norfolk, NE 68701

For complete information: **402-371-0080**

See us at Electronica, Booth 14-C-26.

CIRCLE 653



NTC Thermistors for Surface Mounting.

Dale's H and W.

A choice of two Dale chip-style thermistors makes it easier to integrate temperature measurement and control into hybrid and surface-mounted design. Type "H" has silver wraparound terminations on each end. Type "W" has silver terminations on top and bottom surfaces. Both are available in $\pm 5\%$ and $\pm 10\%$ tolerances with R_{25} values from 50 ohms to 1 meg. depending on type and size. For information and technical assistance, contact: Dale Electronics, Inc., Western Thermistor Division, 2300 Riverside Blvd., Norfolk, NE 68701

Phone this number today: **402-371-0080**

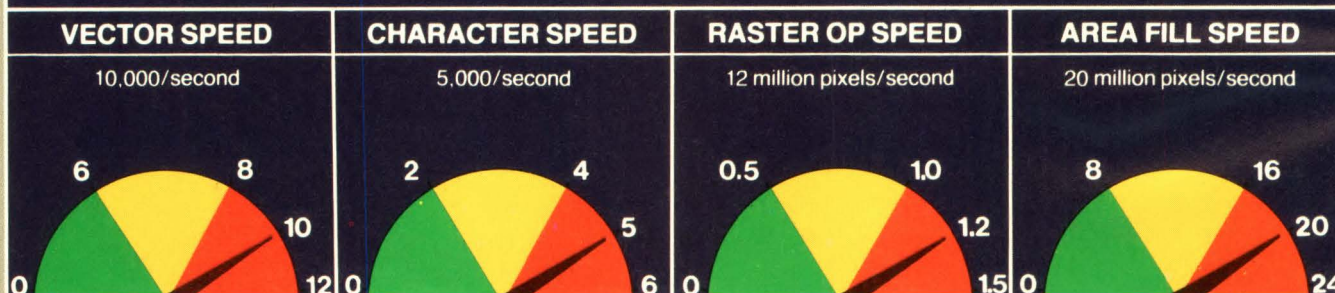
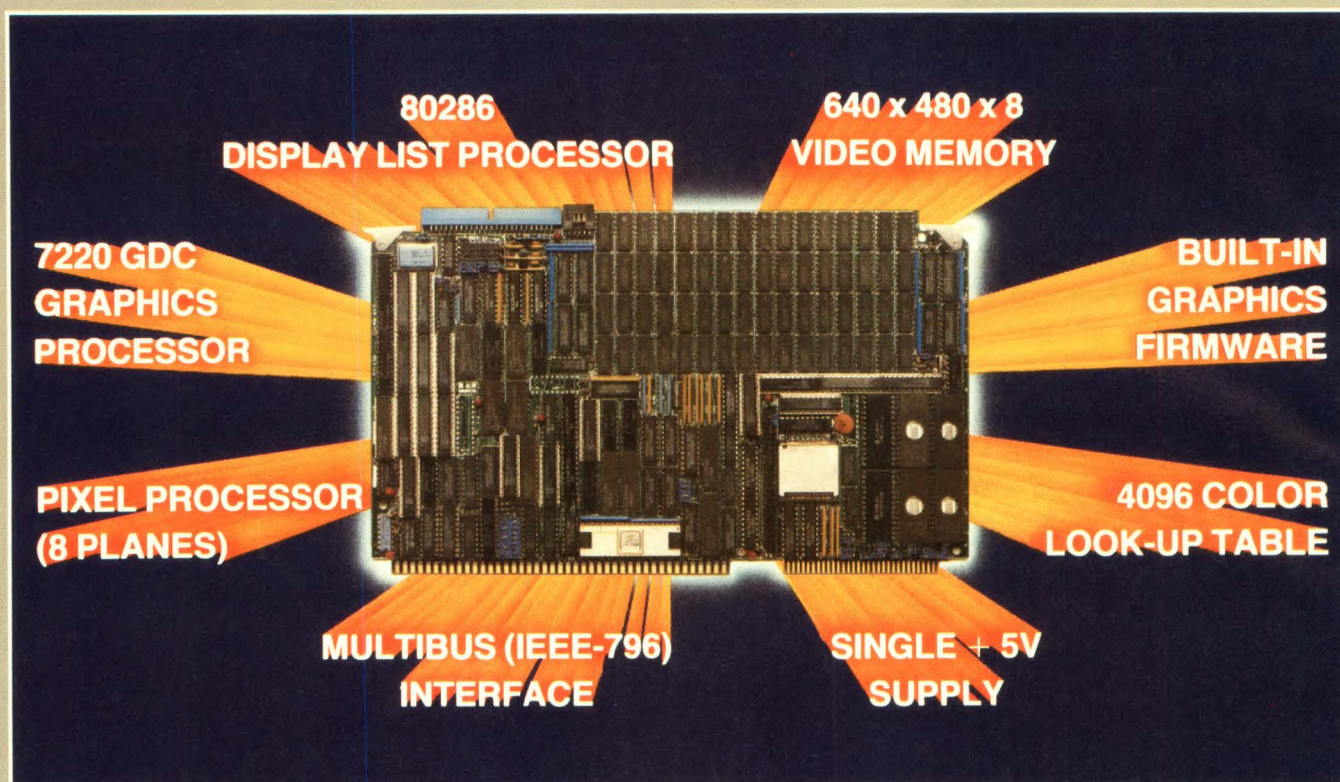
See us at Electronica, Booth 14-C-26.

CIRCLE 654

Dale makes your basics better.



BREAKTHROUGH IN MULTIBUS GRAPHICS!



SX-900 - The New Performance Standard For Color Graphics Boards

- Powerful on-board graphics firmware
- 640 x 480 x 8 bits/pixel
- 50/60Hz non-interlaced refresh
- 4096 color look-up table
- 80286 display list processor
- 7220 GDC graphics primitive processor
- 8 plane pixel processor

The new Matrox SX-900 is a high performance color graphics display controller. It is the perfect solution for OEM manufacturers of process control and instrumentation equipment. The SX-900 is software compatible with the popular Matrox GXB-1000A high resolution display controllers, but occupies only a single Multibus card slot, and provides high speed drawing capability.

The hardware provides 640 x 480 pixel resolution, 4 or 8 bit planes, a 4096 color look-up table, and a 60Hz flicker free video refresh rate. The fast performance of the SX-900 results from a multi-processor pipelined architecture. A powerful 80286 CPU is used as the front end display list processor and is supported by a 7220 graphics primitive

- Built-in diagnostics
- Complete IEEE-796 (Multibus) interface
- +5V only power required
- 10,000 vectors/second
- 5,000 characters/second
- 1,200,000 pixels/second raster ops
- 20,000,000 pixels/second area fill

processor and a high speed pixel processor for simultaneous 8 plane drawing.

The SX-900 incorporates the proven on-board graphics firmware used by the GXB-1000. Over 256 high level display list commands are supported including line drawing, character drawing, circle and arc drawing, area fills, cursors and raster ops.

In addition to graphics boards, Matrox can also supply color monitors, cardcages, CPU cards, memory boards, and communications controllers for complete OEM display system requirements.

80286, MULTIBUS - TM INTEL • 7220 - TM NEC

Call now for a complete documentation package.



matrox
electronic systems ltd.

1055 St-Regis Blvd.
Dorval, Quebec
Canada H9P 2T4
Tel.: (514) 685-2630
Telex: 05-822798

CIRCLE 599

DISTRIBUTORS IN THE U.S. AND CANADA

BC ELECTRONIC SALES CO.

1 Hillside Ave., Williston Pk, NY 11596, Tel.: 516-747-6610

MURKIN-KREH ASSOCIATES

100 Security Blvd, Suite 330, Baltimore, MD 21207,
Tel.: 301-265-8500

314 Timberlake Rd, Lynchburg, VA 24502, Tel.: 804-239-2626

COMPUTER MODULES INC.

190 Miraloma Way, Suite Y, Sunnyvale, CA 94086,
Tel.: 408-737-7727

GEISTING & ASSOCIATES

712 Hamilton Ave., Cincinnati, OH 45231, Tel.: 513-521-8800

2765 Hesler Dr., Novi, MI 48050, Tel.: 313-348-3811

71 Walnut St., Pittsburgh, PA 15238, Tel.: 412-963-0727

HIGH TECH DIGITAL

708 Highgrove Ave., Torrance, CA 90505, Tel.: 213-378-5131

GEN-RAY SYSTEMS

200 West 73 St., Minneapolis, MN 55435, Tel.: 612-831-5060

KLM GARNER

11 Marsh Rd, Pittsford, NY 14534, Tel.: 716-381-8350

KNOWLES ASSOCIATES

1200 Bistleton Ave., # 16B, Feasterville,
PA 19047, Tel.: 215-322-7100

MICRO-TEX INC.

1375 Remington Rd, Schaumburg, IL 60195, Tel.: 312-885-1131

MYCROSYSTEMS MARKETING

1006 Hampshire Lane, Richardson, TX 75080, Tel.: 214-669-2380

2100 Tangle Wild Rd, Houston, TX 77063, Tel.: 713-270-7045

NOVA SALES

2 Militia Dr, Lexington, MA 02173, Tel.: 617-861-1820

P.A.R. ASSOCIATES

20100 E. 32nd Ave., Parkway, Aaron, CO 80011, Tel.: 303-363-6636

4750 Wiley Post Way, Salt Lake City, UT 84116, Tel.: 801-537-1900

PEN-TECH ASSOCIATES INC.

Pen-Tech Bldg, 3709 Alliance Dr, Greensboro, NC 27407,
Tel.: 919-852-6000

1398 Semoran Blvd, Casselberry, FL 32707, Tel.: 305-645-3444

201 SE 15th Terrace, Deerfield Beach, FL 33441,
Tel.: 305-421-4989

627 Cherokee St., Marietta, GA 30060, Tel.: 404-424-1931

3322 South Memorial Parkway, Huntsville, AL 35801,
Tel.: 205-881-9298

TRACAN ELECTRONICS CORP.

1200 Aerowood Dr., Mississauga, Ont. L4W 2S7, Tel.: 416-625-7752

1419 Carling Ave., Ottawa, Ont. K1Z 7L7, Tel.: 613-722-7667

10500 Côte de Liesse, Lachine, Qué. H8T 1A4, Tel.: 514-636-8380

WESTER BERG & ASSOCIATES

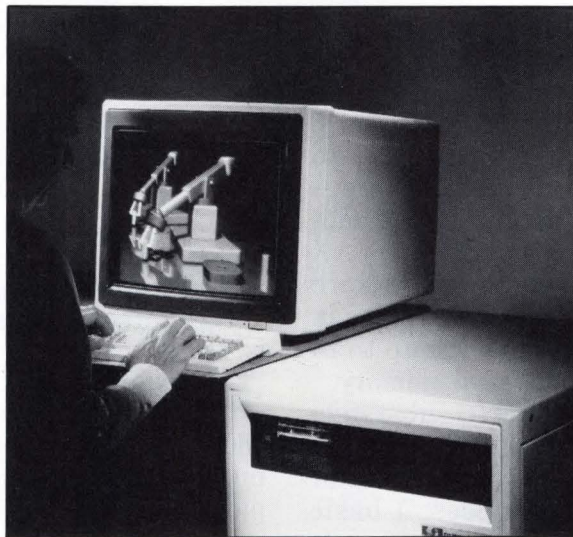
12505 NE Bel-Red Rd, Bellevue, WA 98005, Tel.: 206-453-8881

2035 SW 58th Ave., Portland, OR 97221, Tel.: 503-297-1719

NEW PRODUCTS

COMPUTER SYSTEMS

CAE workstation works at 2 MIPS



Computationally intensive engineering applications such as IC design fault simulation and mechanical design will get a powerful boost from a workstation that is capable of executing up to 2 million instructions per second. The 32-bit C1200 Professional Workstation, from Celerity Computing, executes up to 2.0 million single-precision and up to 1.5 million double-precision Whetstones.

Approximately 1.5 to 2 times the throughput of a VAX-11/780, this performance is mainly a consequence of its CPU, the NCR 32000 chip set, which employs separate 32-bit address and data paths and a separate 16-bit instruction path.

The workstation's capabili-

ties will support high-resolution color graphics. For example, it can compute over 60,000 1-cm vectors/s for display on a 1280-by-1024-pixel monitor. The 60-Hz noninterlaced monitor can display over 256 simultaneous colors from palette of 16 million.

Other features include a large local memory of 2 to 24 Mbytes, disk storage of up to 720 Mbytes, and a fast networking capability. Software can be built on the Unix operating system (4.2 BSD), with Fortran 77, Pascal, and C compilers.

The workstation is priced at \$64,500, including floating-point processor, 56-Mbyte disk, streaming-tape backup, and color graphics.

Celerity Computing, 9692 Via Excelencia, San Diego, Calif. 92126; Fred Dudley, (619) 271-9940.

CIRCLE 307

Stephan Ohr

COMPUTER SYSTEMS

Workstation delivers power and performance

Intended for high-performance engineering applications, the C1200 professional workstation executes 2 million single-precision and 1.5 million double-precision Whetstone instructions/s. The 32-bit Unix-based workstation offers performance that is 1.5 to 2 times faster than that of the VAX 11/780 at less than one-third the cost. What's more, it can be configured with up to 24 Mbytes of physical memory.

The C1200's I/O subsystem is based on the Multibus to give users a wide choice of peripheral devices. A basic

system configuration includes the 32-bit Accel processor, an extended floating-point processor, a 56-Mbyte disk drive, a streaming cartridge tape drive, and 2 Mbytes of ECC memory.

Celerity Computing, 9692 Via Excelencia, San Diego, Calif. 92126; (619) 271-9940. From \$45,000; November.

CIRCLE 339

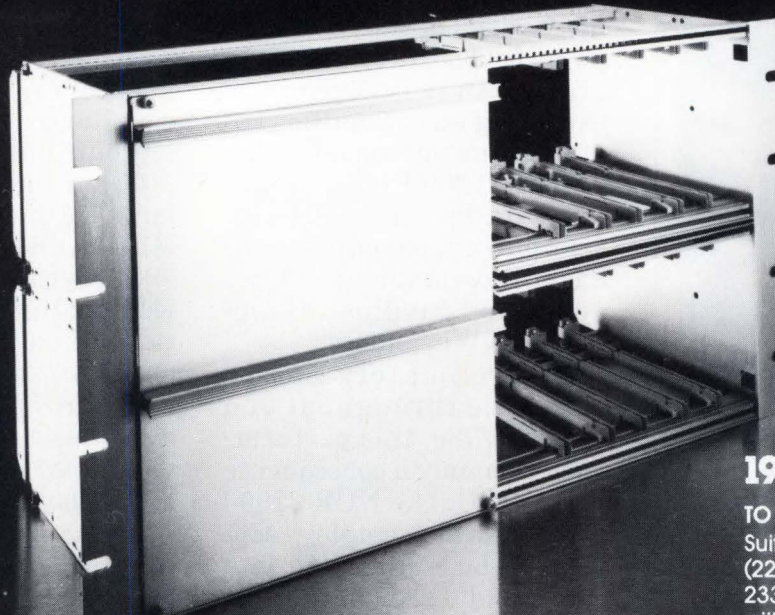
Multi-user computer has integral streamer

The newest member of the System 3200 family of 68000-based multi-user computers, the Model 3220 employs a 53-Mbyte Winchester

disk drive and a built-in 47-Mbyte streaming cartridge tape drive for high-speed backup. The desktop unit permits Winchester expansion to 100 Mbytes and supports up to five workstations. The workstations are linked by a high-speed multidrop coaxial connection, which transfers data at a rate that is more than ten times faster than RS-232-C connections. The 3220 supports several popular languages—including RM/Cobol and Basic—which can be executed concurrently.

Pertec Computer Corp., 17112 Armstrong Ave., Irvine, Calif. 92713; (714) 660-0488. From under \$14,000.

CIRCLE 340



OK Industries Inc. offers a complete and versatile line of economically priced 19" Sub-racks and accessories.

19" Sub Racks

TO IEC 297, DIN 41494 PARTS 1-5
Suitable for Euroboards 100×160 (220)mm and for double Euroboards 233,4×160 (220)mm in conjunction with connectors, priority to IEC 603-2, DIN 41612, VG 95324 and MIL-C-21097.

CIRCLE 601

3455 Conner Street, Bronx, New York, 10475, U.S.A.
Telex 125091 OK NYK, Telex 232395 OK NY UR.
Phone (212) 994-6600.

OK
Industries
Inc.





In October, Electronic Design has something extra for career-minded engineers

Career Extra is the industry's only recruitment newspaper for 118,000 professional engineers. Our career-oriented articles and interviews with leading Personnel Managers give readers a complete assessment of employment trends and opportunities.

Like which engineering titles are currently in demand. And by whom.

Which industries are on the rise and are bringing new employment opportunities. And which ones aren't.

The new strategies companies are

taking to overcome manpower shortages. And what alternative methods they're using to recruit working engineers.

News about career development centers and college relations programs.

Plus exclusive career studies surveying industry conditions, attitudes and opinions.

As an Electronic Design subscriber, you'll receive four issues of Career Extra in 1984. The next one's coming in October. Don't miss it!

COMPUTER SYSTEMS

Micro outperforms compatible PC XT

Offering both IBM PC XT-compatible stand-alone processing and shared system processing, the Mega PC

microcomputer is capable of supporting up to eight user workstations. Furthermore, the Mega PC boasts performance that is up to two times faster than that of the PC XT—the result of a higher

speed 8-MHz processor.

The file server unit of the Mega PC houses an 8088-based processor board and 256 kbytes of RAM. In addition, the file server contains a 10-, 20-, or 40-Mbyte Winchester disk drive; a floppy-disk drive; one serial port; and one parallel port.

Corona Data Systems Inc.,
275 E. Hillcrest Drive, Thousand Oaks, Calif. 91360; (805) 495-5800.

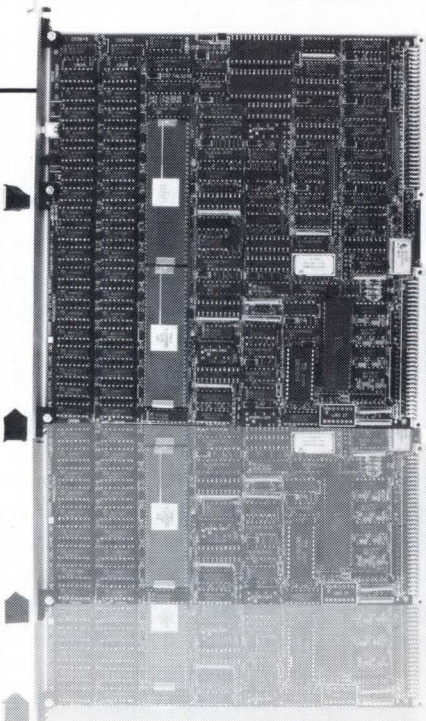
CIRCLE 341

VME SBC with **ONE MEGABYTE**

Performance Oriented

- Dual-ported memory with parity
- Zero wait states
- 68000 CPU
- Multi-master capability
- System control functions
- Optional MMU
- Two RS-232C channels

The DVME-102 from DY-4 has proven its performance record in the field, and lends its features to ease of System Design. A full One Megabyte of on-board memory eliminates the need for data transfer across the VMEbus. Send for more on the DVME-102 and the entire line of VME modules from DY-4 Systems.

**DY-4 SYSTEMS INC.**

1475 S. Bascom Ave, Campbell, CA 95008, (408) 377-9822
888 Lady Ellen Place, Ottawa, Ontario, Canada K1Z 5M1 (613) 728-3711
Solbakken 48, DK-8450, Hammel, Denmark (06) 96-3624 TLX 60938 (Dendy DK)

CIRCLE 603

Dual-processor micro rivals VAX-11/780

The first in a series of multiple-processor systems for on-line information processing, the Model 1124 features a dual 68000/Unix-based engine that is 30% faster than the VAX-11/780. Moreover, the supermicrocomputer is one-third the cost of the VAX. In addition to Unix System V, the 1124 supports the Cobol-compatible RM/COS, which permits high-speed file access at the operating system level.

The computer provides ten card slots to accommodate a variety of user configurations. Three slots are for CPU and memory cards, while six are for I/O expansion. The remaining position is reserved for a memory controller that manages the data flow among system cards. Memory is currently available in 2-Mbyte increments.

Arete Systems Corp., 2040 Hartog Drive, San Jose, Calif. 95131; (408) 263-9711. From \$60,000 to \$75,000; 60 days.

CIRCLE 342

NEW DISCOVERY FILLS GAP IN SYSTEMS EVOLUTION

THE MISS

Synertek's 1Kx8 Dual-Port RAM.



SY 2130

Synertek has discovered the Missing Link in next-generation systems design:

Our new 2130 Dual-Port RAM.

It's perfectly adapted to applications where only the smallest, fastest and most efficient can survive.

It's the connection you need in DSP and high-

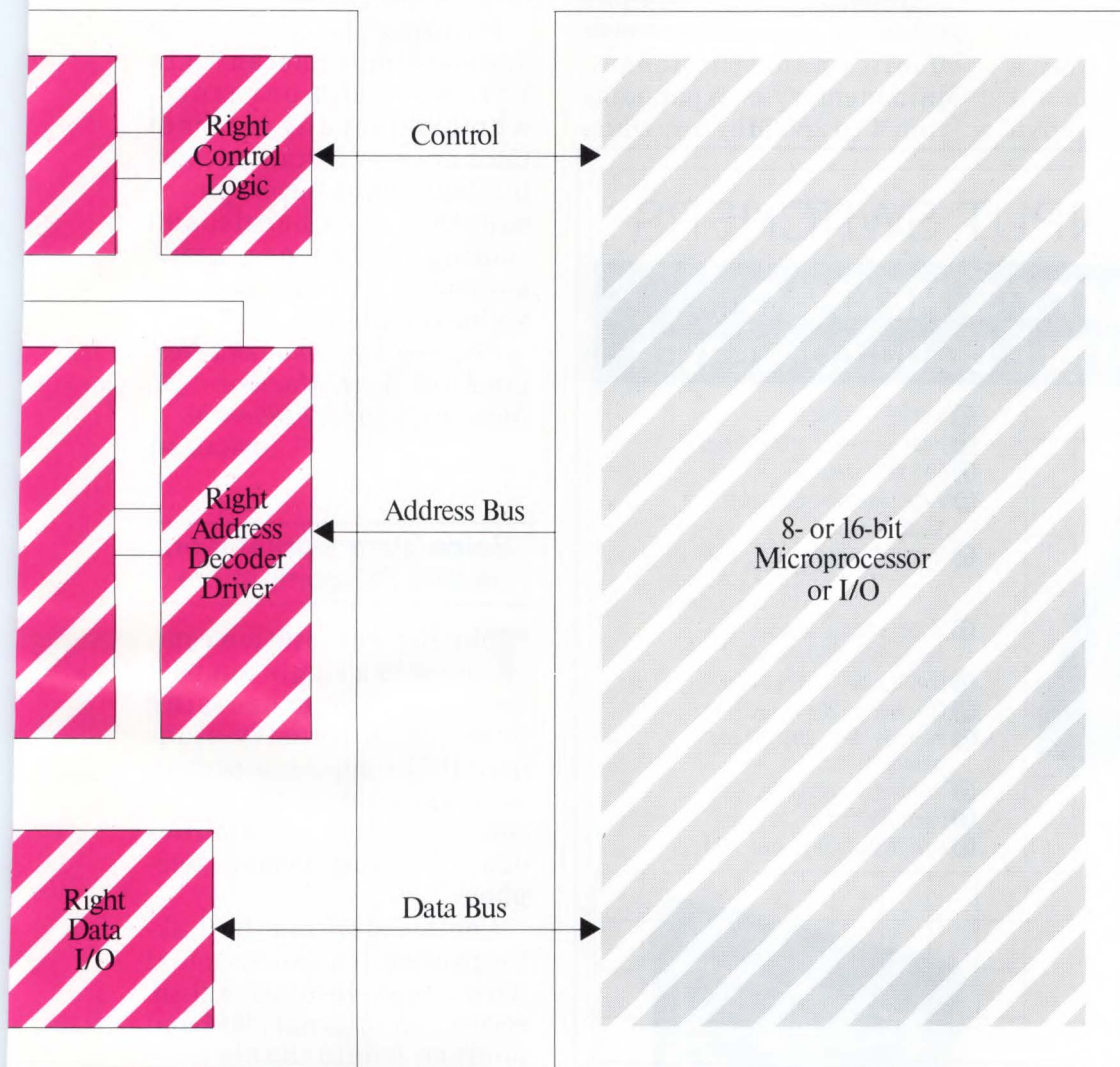
speed I/O where a common memory is shared with a microprocessor. Or in message passing applications where two different 8- or 16-bit CPU's share a memory.

Why? Because the 2130's 8-transistor dual-port memory cell reduces contention to the byte level. And because our 2130 replaces up

to 16 discrete parts. So it gives you more reliability in less space with less power consumption. Reduces memory access time by half. And—with access times as fast as 100 ns—matches your most stringent system requirement while eliminating wait states.

In short, it makes your design job easier. (We've

NG LINK



been dedicated to that—and to evolving new and more elegant memory products—for over a decade.)

So link up with Synertek's new 2130 Dual-Port RAM. Return the coupon today for a data sheet and application note. We're sure you'll find it a natural selection.

Synertek Inc., 3001 Stender Way, Santa Clara, CA 95054 (408) 988-5600.

YES, I've been searching for the Missing Link.
Tell me more about your new SY2130 Dual-Port RAM.

Name

Title

Company

Address

City State Zip

Telephone

Synertek.

A Honeywell Subsidiary.

COMPUTER SYSTEMS

Multiprocessor system offers fault tolerance

Featuring a fault-tolerant implementation of Unix, a multiprocessor system not only boasts high throughput,

but large memory and I/O capacities as well. Processing capabilities for the Sequoia system range from 2.5 to over 50 million instructions/s. Main memory is expandable from 4 to 256 Mbytes, while

I/O consists of 2 to 96 channels—each supporting up to 16 controllers.

Forming the basis of the system's fault tolerance are hardware comparators, which detect any internal fault or error instantaneously. Redundant buses, power supplies, peripherals, and cooling equipment provide automatic recovery from disabling conditions.

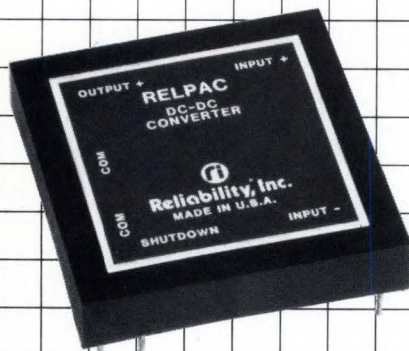
Sequoia Systems Inc., Boston Park West, Marlborough, Mass. 01752; (617) 480-0800.

CIRCLE 343

NEW WIDE INPUT SWITCHERS

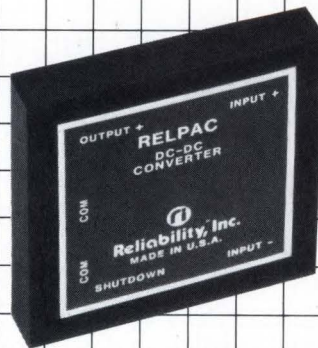
RELIABILITY'S RELPACTM
BATTERY COMPATIBLE DC-DC CONVERTER

75% EFFICIENCY



- ❶ Battery Compatible
- ❷ High Efficiency: 75% Typical
- ❸ 500 VDC Isolation
- ❹ Wide Input-voltage Range: 12-36 VDC
- ❺ Output Current: 5VDC, 1000mA
12VDC, 425mA
15VDC, 333mA
- ❻ Under voltage lockout set at 10.5 VDC $\pm$ 5%
- ❼ Low Profile: 2"x2"x.375"
- ❽ Low Noise: 20mv true R.M.S.
- ❾ Package: Six sided copper (standard)
- ❿ Remote Shutdown
- ⓫ Internal pi filter
- ⓬ Low Noise: 20mv true R.M.S.

70% EFFICIENCY



- ❶ Battery Compatible
- ❷ High Efficiency: 70%
- ❸ Minimum @ nominal 12VDC
- ❹ Wide Input-voltage Range: 7-17 VDC
- ❺ Output Current: 5VDC, 1000mA
12VDC, 425mA
15VDC, 333mA
- ❻ 500 VDC Isolation
- ❼ Output Voltage Adjustment; Optional
- ❽ Low Profile: 2"x2"x.375"
- ❾ Low Noise: 20mv true R.M.S.
- ❿ Package: Plastic, (optional Copper Case)
- ⓫ Remote Shutdown

RELIABILITY NEDERLAND B.V.
GORTLANDROE INDUSTRIAL ESTATE
NENAGH COUNTY TIPPERARY
REPUBLIC OF IRELAND
TEL: (067) 31897 TWX 852-26833

RELIABILITY INCORPORATED
POWER SOURCES DIVISION
P.O. BOX 218370, HOUSTON, TX 77218
PHONE: (713) 492-0550
TWX: 910-881-1739



CIRCLE 605

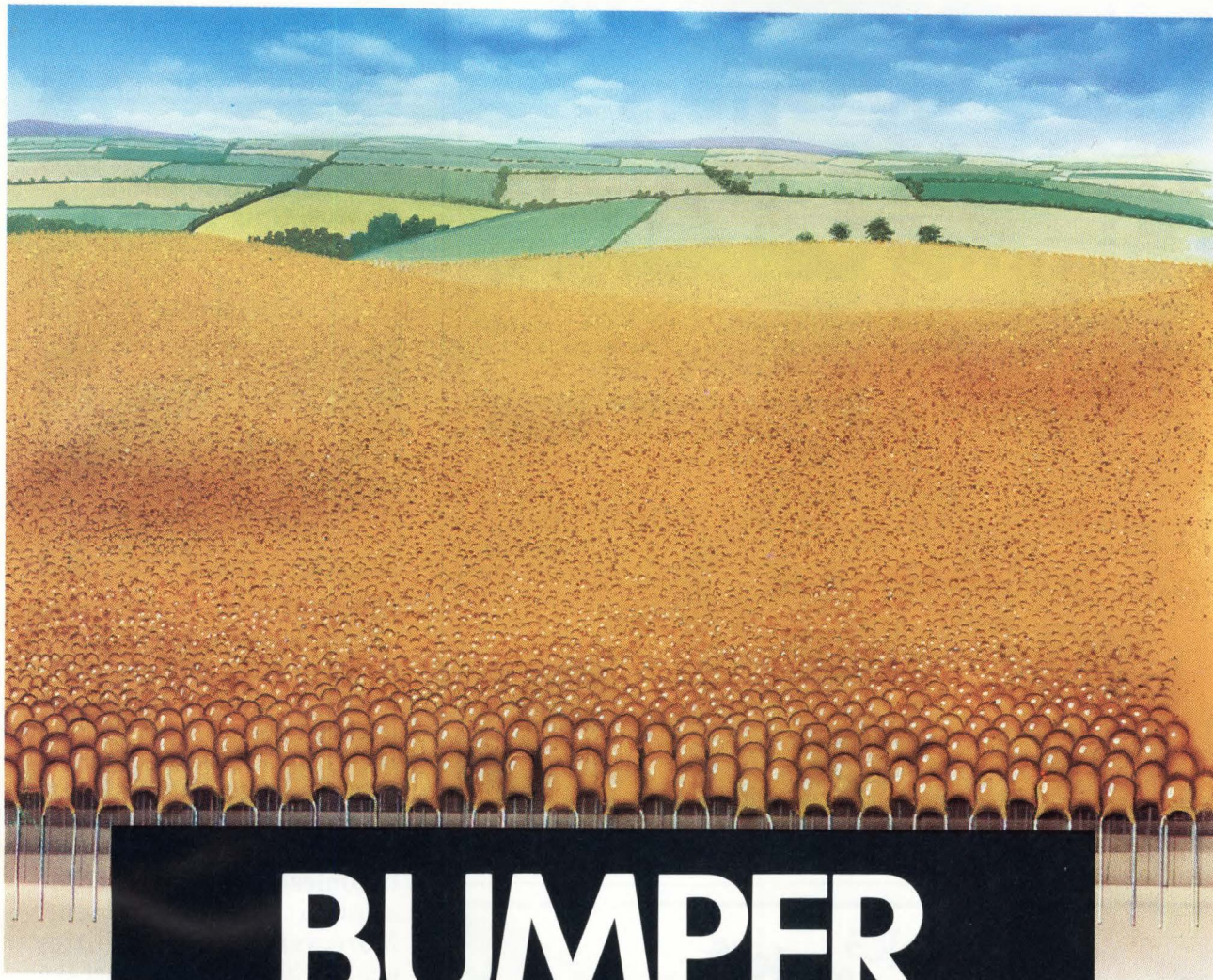
Voice/data workstation is IBM PC-compatible

The E.3 workstation combines in a single compact footprint the processing power of an industry-standard IBM-compatible personal computer with the verbal communications capabilities of a full-feature business telephone.

Contained within the desktop package is a data terminal with a high-resolution 9-in. screen, an internal 300-baud modem, a detachable keyboard, a 360-kbyte 5¹/₄-in. diskette drive, a telephone, and support software. Integrated multiple processors allow the telephone and the computer to operate independently or concurrently as the application requires. The ES.3 features 128 kbytes of user memory, expandable to 640 kbytes.

Zaisan Inc., 13910 Champion Forest Drive, Houston, Texas 77069; (713) 580-6191. \$2595.

CIRCLE 344



BUMPER HARVEST.

Most people will have to wait for their harvest, you can reap yours now.

STC Components now has two new production sites in England and Germany, that's in addition to our existing plant in Britain. That means there will be enough Solid Tantalum Capacitors to satisfy the appetite of the world's electronics industry.

It gives us the largest tantalum

capacitor capability in Europe.

And we haven't stopped developing. New ideas are taking root, right now.

Give yourself some food for thought.

STANTEL Components

636 Remington Road, Schaumburg, IL 60195
Telephone (312) 490-7150 TWX (910) 291-1280
FAX (312) 490-9707

CIRCLE 607

STANTEL CORPORATION A member of the Standard Telephones and Cables plc group of companies.

Sprague-Goodman. Nobody Offers a Broader Selection of Trimmer Capacitors.

When it comes to high-quality trimmer capacitors, nobody comes close to Sprague-Goodman.

We have the world's largest selection of models, styles and dielectrics: sub-miniature glass, quartz and sapphire Pistoncaps® plastic Filmtrims® or Ceramic single turn, Mica compression, Airtrim® air dielectric, multi-turn plastic and miniature LC tuners and Strab-L® metalized inductors.

So whether you

need standard or custom products, you can count on Sprague-Goodman. The first and last name in trimmer capacitors.

**Sprague-Goodman
Electronics, Inc.**

**SPRAGUE
GOODMAN**

(An affiliate of the Sprague Electric Company)

134 Fulton Avenue,
Garden City Park, NY 11040
516-746-1385
TLX: 14-4533



CIRCLE 608

NEW PRODUCTS

COMPUTER SYSTEMS

**μC is compatible
with Unix System III**



Targeted at engineering environments, the microSystem NX runs the Uni-Plus+ operating system—a licensed port of Unix System III with Berkeley 4.1 extensions. With an optional software package, the multitasking single-user workstation becomes a powerful tool for applications development. Moreover, built-in facilities enable the user to connect the microSystem NX with other devices and workstations via the Omninet local area network.

Based on a 68000 microprocessor, the microSystem NX comes with a 15-in. bit-mapped display that has a resolution of 720 by 560 pixels. It is additionally configured with a detachable 113-key keyboard, 512 kbytes of main memory, 64 kbytes of display memory, two RS-232-C ports, a 655-kbyte 5¼-in. floppy-disk drive, and a choice of Winchester capacities. With 12 or 18 Mbytes of Winchester storage, the system costs \$8895 and \$9495, respectively.

Honeywell Inc., 300 Concord Road, Billerica, Mass. 01821; (617) 671-2744. January, 1985.

CIRCLE 345

**For
Connecting Jacks
& Pins, Mill-Max Makes**



**THE
CONNECTION**

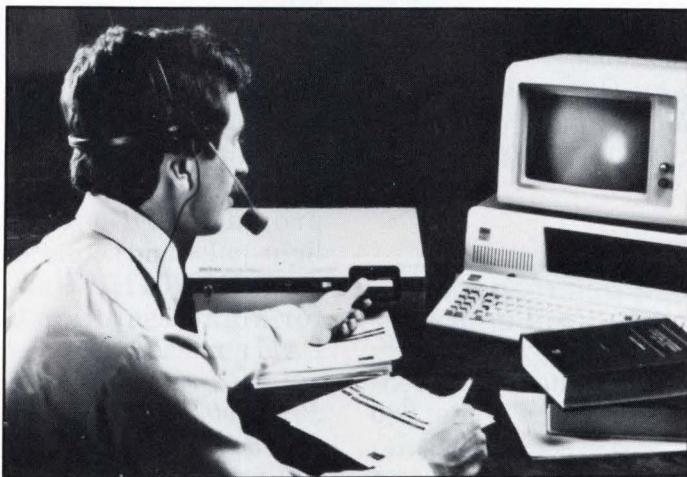


MILL-MAX MFG. CORP.
P.O. Box 300, 190 Pine Hollow Rd.
Dept. L, Oyster Bay, New York 11771
(516) 922-6000 TWX: 510-221-1820

CIRCLE 609

COMPUTER PERIPHERALS

Low-cost unit recognizes 100 continuous words



Coming in at \$4900, a voice recognizer adds low-cost continuous-speech input to virtually any mainframe, minicomputer, or microcomputer, as well as to industrial controllers. A companion software development program lets users create their own data entry vocabulary quickly and easily.

The Series 4000 from Verbox, a portable unit comprising a console 18 by 13 by 3½ in. and a microphone headset, offers all the obvious advantages of continuous-speech recognition.

The recognizer has a vocabulary of 100 words and achieves an accuracy of better than 99% even in industrial environments with 85 dB of background noise. It employs a ROM cartridge that enables the system to respond only to words spoken by him or her.

Gary Elinoff

When that user finishes, any other person who has created a data cartridge can plug that one in, and after a 0.5-second wait, the system will again be ready to accept verbal input.

The system can also operate with vocabularies and speech patterns stored directly in the host computer's memory. In addition to providing a beep tone indicating recognition completion, it allows for verbal verification of the input.

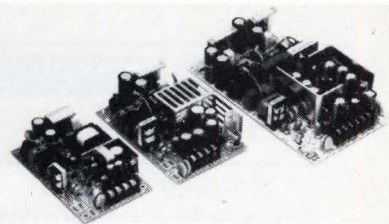
The Voice Planner software lets users develop data cartridges for the Series 4000. It runs on any personal computer operating under MS-DOS or PC-DOS, as well as on VAX and other minicomputers.

The \$4900 price is for a single unit; the software costs \$5000. Delivery will start in January.

Verbox, 2 Oak Park, Bedford, Mass. 01730; Jeff Frost, (617) 275-5160.

CIRCLE 312

KEC OFFERS NEW WORLD CLASS SERIES OF SWITCHING POWER SUPPLIES



KEC Electronics has added to its switching power supply line by introducing a new World Class KFD Series. The Series consists of 25W, 40W, and 80W multi-output units that are designed for products sold to the world market.

The KFD Series is designed to meet international safety specifications IEC 350 and VDE 0806 as well as UL/CSA. For EMI, the series complies with VDE 0871 level B and FCC level B.

These new units incorporate the latest IC technology and are available with three outputs in 30 different voltage/ampere ratings. The KFD Series is ideal for a wide variety of applications in CRT terminals and modems or wherever outstanding reliable performance in compact multi-output units is required.

The 25 piece unit prices in the U.S.A. are: \$44 for the KFD 25E, \$52 for the KFD 40E, and \$92 for the KFD 80E. Substantial discounts are available for higher quantity orders. Delivery on sample quantities is from stock; production quantities are to the customer's schedule.

For more information, contact:

KEC Electronics, Inc. 20817 Western Avenue, Torrance, CA 90501, Phone: (213) 320-3902.

CIRCLE 610



At Tauber Electronics, We run on batteries. . . With Panasonic Lithiums, we run farther.

Panasonic's unique chemistry offers a high degree of safety and very stable discharge voltage of 3v nominal. Operating temperature range: -40°C to +85°C, 10 year shelf life. UL listed cells for memory back up, communications, photo flash and instrumentation are available in a wide variety of PC mounts and battery pack assemblies. Best of all, we've got stock.

Panasonic

TAUBER ELECTRONICS INC.

Panasonic 1983 Distributor of the Year—Battery Sales Division.

4901 Morena Blvd. ste. 314

San Diego, CA 92117

619/274-7242; No. CA 408/737-9408

CIRCLE 611

COMPUTER PERIPHERALS

**Hard-disk drive
boasts fast response**

To meet the demands of multi-user network environments, a mass-storage Winchester disk drive boasts an average access time of 18 ms and a storage capacity of 160 Mbytes. The Atlas disk drive incorporates 50 read/write heads on three platters, which can be stepped to a total of 160 cylinders or 8000 individual tracks. Each cylinder provides the computer with microsecond access to a full Mbyte of data. The 50-head configuration reduces the amount of arm movement and accommodates better than 70% more user-requests

than conventional 10-head systems, which require more arm movement and produce slower response rates. The Winchester disk drive is interface- and format-compatible with ANSI SMD specifications.

Alpha Data Inc., 20750 Marilla St., Chatsworth, Calif. 91311; (818) 882-6500.

CIRCLE 346

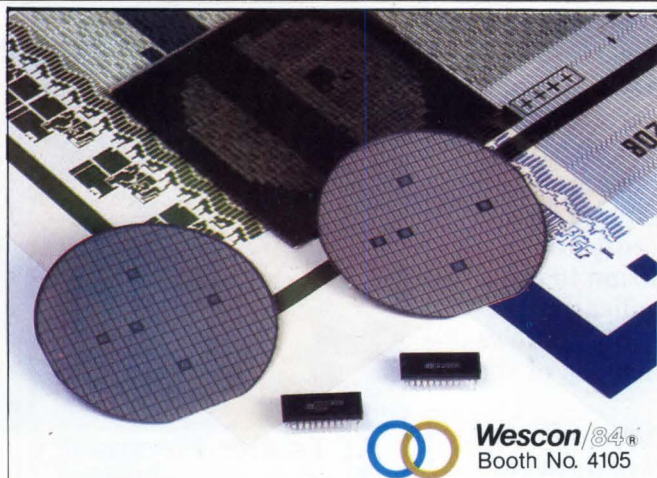
**Light pen responds
to low-level inputs**

With extremely high sensitivity, the Model 260 HP light pen serves such demanding applications as those where the luminance is

as low as 0.2 fL. The pen features a push-tip actuator, which has a life expectancy of more than 2 million operations, and an electronic assembly with an MTBF in excess of 183,000 hours. A light pulse output is produced in less than 0.5 μ s in response to a 2-fL input. Completely self-contained, the pen operates from a single 5-V source and provides TTL-compatible light-pulse and actuation outputs. The 260 HP is suitable for high-resolution CAD/CAM applications.

Interactive Computer Products Inc., 23591 El Toro Road, Suite 180, El Toro, Calif. 92630; (714) 770-5332.

CIRCLE 347



Wescon/84
Booth No. 4105

ERSO Stands For Quality In The IC Industry

To build your high-quality systems, you need high-quality components from ERSO. With 3 μ m high performance CMOS and NMOS manufacturing experience, ERSO can help you through reliability and cost effectiveness. Contact us for services hard to come by elsewhere!

PRODUCT LINES:

- * Telephone ICs
- * Speech Synthesizer ICs
- * Mask ROMs
- * Microcomputer ICs
- * A/D, D/A Converters
- * Melody ICs
- * Full-custom Design
- * Semi-custom Design: Gate array
- * Foundry



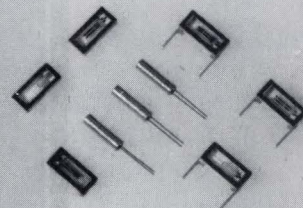
8th Fl., No. 315, Sung Chiang Rd., Taipei, Taiwan, R.O.C.
Telex: 12974 ERSO ITRI Tel: (02) 542-8212
U.S. Liaison Office: 2950, Scott Blvd., Santa Clara, CA. 95050
Telex: 171128 ITRI CA. Tel: (408) 727-1280, 727-1281

CIRCLE 612

**Miniature Quartz Crystals for
Microelectronics: 10kHz - 2 MHz**

These miniature quartz crystals from ETA are tailored to modern microelectronics requirements. Employing technologies as used for high volume IC production, these crystals offer features with respect to economy, electrical and mechanical characteristics which can hardly be beaten by any comparable product.

- Hermetically sealed metal cans ($\varnothing 2 \times 7.5$ mm) or ceramic packages ($8.4 \times 3.9 \times 2$ mm) with IC compatible leads or contact pads for reflow solder or conductive epoxy mounting
- Precision tuned by laser technique
- Ultra low aging, excellent stability
- Highly shock and vibration resistant
- Low power consumption, high performance
- Standard frequencies available off the shelf, any other frequency — also in large quantities — with short delivery times



For details on these fine quartz crystals call or write to:

Th-1/84ETA



ETA SA Fabriques d'Ebauches
Quartz Division

Ch - 2540 Grenchen, Switzerland, Tel. 065 - 51 21 11, Telex 934 384 eta ch
ETA Industries Inc.
608 Fifth Avenue, New York, N.Y. 10020, Tel. 212-307-5276, Telex 239865

CIRCLE 613

Please see me about
high-efficiency TO-220
rectifiers and Schottkys
Claire

RECTIFIERS

Here's my findings on what we talked about.

Problem: Our present source has let us down! We have to find a committed and motivated source for providing high-quality, high-efficiency rectifiers and Schottkys in TO-220 packages at a competitive price. Characteristics required: low V_f , ultra-fast recovery (t_{rr}), and high current.

Solution: Unitrode. They're the obvious leaders in this area - in fact, they invented ultra-fast recovery rectifiers. They're already our source for other key power supply and motor control components. No one else compares for understanding our applications. They can deliver on 10,000 units in 2-4 weeks and they're priced right - under \$1.00 each on 100 pieces. Unitrode is my best recommendation.

Paul

TO-220 Rectifier Performance		
Series	UES UES1400, 2400,1500	Schottky USD600,(C)*,700, (C)*,800,900
Voltage	50-200V	20-45V
V_f	.895mV	.48V
t_{rr}	35nSec	
I	8-16A	6-16A

*Center tap

COMPONENT ENGINEERING DEPARTMENT



UNITRODE
THE POWER IS IN OUR SOLUTIONS

For a copy of Unitrode's Rectifier Selection Guide and product samples, contact the following Unitrode Field Offices: Northeast, (Boston) 617-245-3010; Metro - New York 516-271-3110; Southeast, (Tampa) 813-932-5807; Midwest, (Chicago) 312-394-5240; North Central, (Dayton) 513-294-1364; Southwest, (Dallas) 214-231-8700; Southern California, (Los Angeles) 818-705-8085; (Orange County) 714-730-1077; Northern California, (San Jose) 408-294-4210.

COMPUTER PERIPHERALS

**Stand-alone unit
generates graphics**

The Personal Graphics System (PGS) is a stand-alone graphics generator with the capabilities of a

\$20,000 system at a price of only \$3495. It offers a 780-kbyte memory and a choice of 2.1 million colors. The system displays 512 by 480 pixels on its 19-in. monitor, and its icon menu is driven via a mouse or

trackball device.

The PGS utilizes a frame grabber and digitizer that accepts signals from a television, VCR, or video camera and digitally freezes the picture for further manipulation. Synthetic color routines allow the user to change the color saturation and/or hue of individual pixels or sets of pixels. An RS-232-C port is provided for interfacing the PGS with most popular personal computers.

Inovion Corp., 195 E. Gentile St., Suite 7C, Layton, Utah 84041; (801) 546-2850.

CIRCLE 348

Pylon's test heads are your best value for Teradyne L200 Series ATE!

They're designed for maximum performance!

Pylon L200 test heads offer the advanced features and quality construction that make them your best test head value for in-circuit and functional testing. Our integrated high-vacuum-flow connection and simple, time proven sealing method mean positive board positioning providing maximum test performance. Other standard features include a ground plane, carrying handles, durable construction, and a snap-off frame for quick access to POGO® Contacts. All of these features, backed with Pylon's reputation for quality and service, make Pylon's L200 test heads your *best value*.

Test heads are available in kit form, drilled kits, or fully finished with Pylon's exclusive Biasing-Ball POGO® Contacts installed on single or dual-levels for in-circuit and functional testing in the same test head. Call or write for details and specifications.



AUGAT Pylon
Quality and Innovation

PYLON Company, Inc., Box 2510, Attleboro Falls, MA 02763 A SUBSIDIARY OF AUGAT INC.
Tel: (617) 699-7646 Telex: 948095 Fax Phone: (617) 699-6717
WEST COAST FIXTURE FINISHING FACILITY: AUGAT DATATEX, INC.-PYLON
16742 Stagg St., Van Nuys, CA 91411-(213) 786-3974

CIRCLE 614

**Subsystem works with
Q-bus microcomputers**

A storage subsystem for Q-bus-based computers, such as the Micro/PDP-11 and MicroVAX machines, provides 10 Mbytes of Winchester storage and 400 kbytes of floppy-disk storage. The CI-550 incorporates Digital Equipment's RQDX1 controller, utilizing the MSCP protocol. It also reads and writes the standard RX-50 floppy-disk format to allow media portability.

The CI-550 has an average access time of 75 ms and a transfer rate of 625 kbytes/s. It includes circuitry for error detection and correction, error retry, block-mode DMA, and mapping of defective blocks.

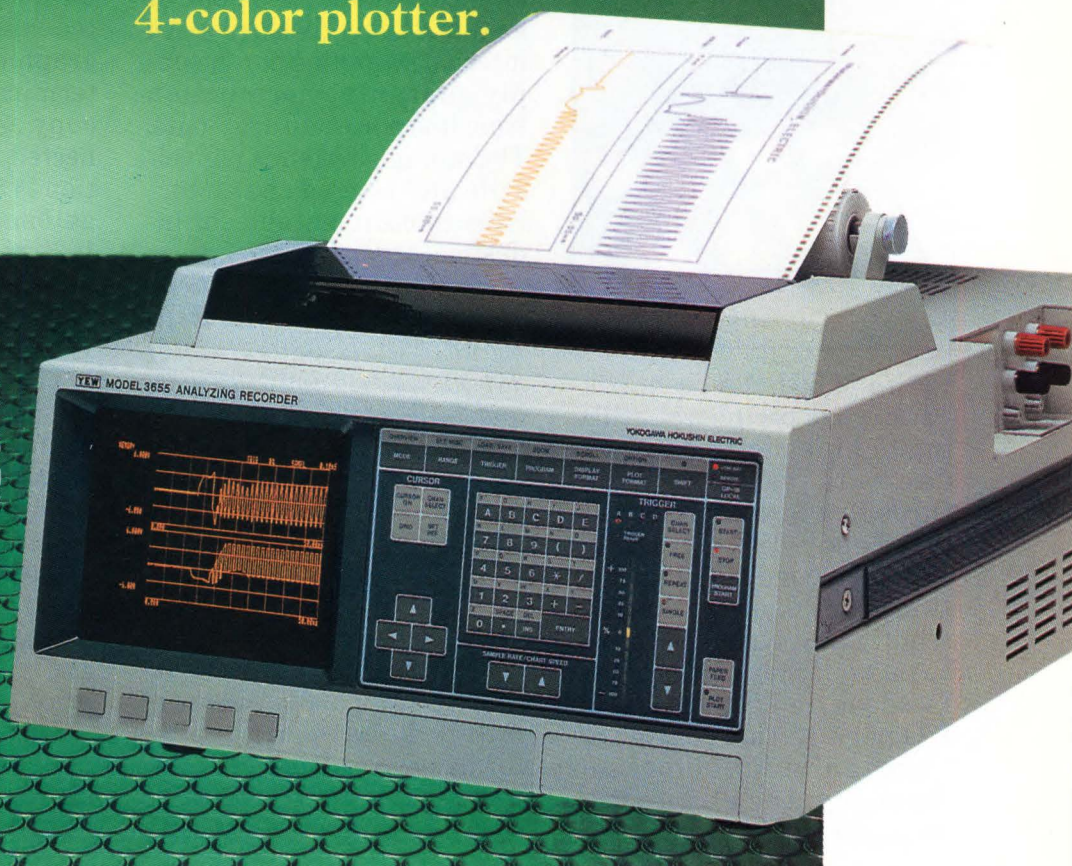
Chrislin Industries Inc., 31352 Via Colinas, No. 101, Westlake Village, Calif. 91362; (818) 991-2254. \$2295.

CIRCLE 349

YEW's New Multifunctions

A powerful tool for waveform analysis.
With computing capability and
4-color plotter.

GP-IB
Model 3655
Analyzing
Recorder



"Multifunctional." That's what you'll call YEW's new Model 3655 Analyzing Recorder once you consider all the multiple functions for waveform analysis, born of the YEW all-in-one design concept. **Powerful multiple functions:** The 3655 is a data logger. Recorder. Transient analyzer. FFT analyzer. And more. **Powerful multiple input:** The 3655 accepts up to 4 channels of DC V and 5 standard TC's. **Powerful multiple presentation of the data:** One touch of a key and the 3655 gives a 4-color hard copy of the CRT display. The 7" CRT and color plotter provide real eye fidelity! The 3655 can digitize signals at a rate of up to 50kHz with 14-bit resolution. And the buffer capacity is 32K words/channel. Discover the 3655 and its many multifunctions. You won't find a more cost-effective tool for waveform analysis! For more information, contact Yokogawa Corp. of America, (404) 253-7000. In Europe: Yokogawa Electrofact B.V. (The Netherlands), (0) 33-10543. In Japan: Yokogawa Hokushin Electric Corp., (03) 349-0621.

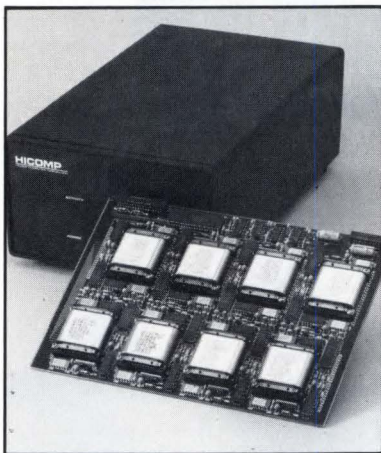


Visit Booth 1469 WESCON'84

YEW
YOKOGAWA HOKUSHIN ELECTRIC

CIRCLE 619

COMPUTER PERIPHERALS

**Bubble storage unit
uses floppy controller**

The MBM-1A, a mass-storage peripheral utilizing bubble memory, interfaces with the host computer through a Shugart-compatible floppy-disk controller. The bubble memory operates as a floppy disk and does not require any system software changes. It may also be interfaced via an RS-232-C serial I/O port. In this configuration, individual blocks of memory are randomly accessed in 512-byte blocks

using simple software commands.

The MBM-1A is available with 0.5 or 1 Mbyte of solid-state nonvolatile storage in an enclosure that is the size of an 8-in. floppy-disk drive. An internal switching power supply guarantees protection from line noise and drop-outs. The storage system's nonvolatile and rugged characteristics make it suitable for industrial applications.

Hicom Computer Corp., 5016 148th Ave. NE, Redmond, Wash. 98052; (206) 881-6030. \$3450 and \$4950 (0.5- and 1-Mbyte versions, respectively).

CIRCLE 350

**Graphics terminal touts
price/performance**

Called the concept GVT+, the Tektronix 4010-compatible graphics display terminal boasts high performance at a cost-effective price. In addition to software-compatibility with

the 4010 model, the concept GVT+ offers a host of additional capabilities, including vector and character erasure or write-over, block fill, memory dump and load, dotted and dashed lines, and graphics memory dim. The terminal also produces hard-copy graphics when connected to a printer. Resolution is 512 by 250 pixels, with automatic scaling to 1023 by 1023 pixels for compatibility with Plot-10 and other standard graphics software for Tektronix terminals.

The concept GVT+ sells for \$1895 with four pages of memory and \$2045 with eight pages of memory (OEM discounts available). An APL version provides both APL and ASCII character sets and Tektronix 4013-compatibility for \$200 above the standard ASCII-only terminal price.

Human Designed Systems Inc., 3440 Market St., Philadelphia, Pa. 19104; (215) 382-5000.

CIRCLE 351



From Taiwan's Most Experienced Producer of Capacitors & Switching Power Supplies---

Teapo traces its history back to the 1930s as part of an integrated manufacturing system specializing in electric and electronic turnout. With Taiwan's largest plant producing CAPACITORS and SWITCHING POWER SUPPLIES, we present a comprehensive line and can handle customer design. See us for metalized polyester film capacitors of VDE & UL standard, Transformers, Dimmers and high-quality SPSs of TP, TM, and TH. Reliable service on all items straight from here or via our U.S. branch.

TEAPO ELECTRONIC CORPORATION

No. 3, Lane 89, Chungyang Rd., Sec. 3,
Tucheng-Hsiang, Taipei-Hsien, Taiwan, R.O.C.
Telex: 31223 TEAPOCO Tel: (02) 260-3517, 260-4151
FAX: (02) 260-8676

TEAPO ELECTRONIC CORPORATION OF AMERICA

6725-C Jimmy Carter Boulevard, Norcross, Georgia, 30071
Telex: 4611052 TECA ATL Tel: (404) 449-0034



CIRCLE 620

INSTRUMENTS

System tests semicustom and custom ICs

One of the first systems to allow design engineers to test their custom and semicustom designs, the Logic Master II, made by Integrated Measurement Systems, cuts testing time 40% to 70%.

The tester has 32 real-time output and 32 real-time input channels. The output channels can be controlled by test programs written in a English-like language (developed by IMS) or in Ada, Fortran, Pascal, C, or Basic.

Each output channel can produce patterns at a 20-MHz rate or at an optional 40 MHz.

Some have non-return-to-zero capability, and all have 1-ns edge placement and three-state control.

The system's 32 input channels can strobe test data into an 8-kbyte memory at 20 MHz. The memory can be expanded to up to 16 kbytes or, with chaining, up to 192 kbytes. The input channels have a 1-ns comparator, the equivalent of a 1-GHz logic analyzer.

The system consists of a test fixture into which the chip under test is plugged. The fixture also has cabling so that it can be attached to a

chip mounted in a prototype board. A second component is the mainframe, which contains the control logic.

The tester can be attached to any terminal, mainframe computer, mini, or CAE workstation over either an RS-232 or an IEEE-488 connection. It is available 12 weeks after order for \$39,300. Also available is the Logic Master I, which is geared to production testing and costs \$29,200.

Integrated Measurement Systems, 9525 SW Gemini Drive, Beaverton, Ore. 97055; (503) 626-7117. CIRCLE 304

A switcher in need is small indeed. introducing VOLGEN"ESK"

VOLGEN introduces "ESK" series of super mini dual input and multiple output AC/DC high speed switching power supply accommodated today's most popular application . . . micro & mini computer, floppy discs, CRT terminals, modem, word-processor, printer and peripheral equipments. At present, "ESK" model is sufficient for UL, CSA and FCC class A requirements, and is available ranging from 20 to 80 watts. We are sure that our VOLGEN will help you complete.

If you'd like to know more about the superiority of VOLGEN's switchers, please call or write.

EXAMPLE: INPUT 90-132 VAC or 180-260 VAC terminal selectable.

DUAL OUTPUT:

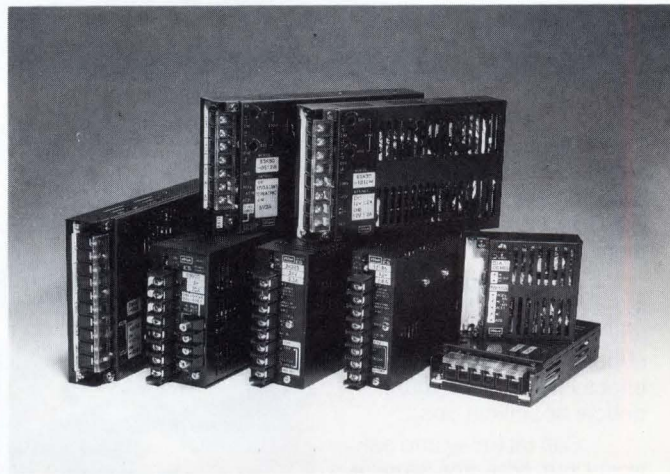
MODEL	CH1	CH2
ESK20-1212W	+12V 1A	+12V 0.6A
ESK30-1212W	+12V 1.2A	+12V 1.2A
ESK50-1212W	+12V 2A	+12V 2A
ESK70-0524WA	+5V 2.5A	+24V 2.5A
ESK80-0524W	+5V 5A	+24V 2A

TRIPLE OUTPUT:

MODEL	CH1	CH2	CH3
ESK20-1212	+5V 2A	+12V 0.4A	-12V 0.4A
ESK30-1212	+5V 3A	+12V 0.5A	-12V 0.5A
ESK50-1212	+5V 5A	+12V 1A	-12V 1A
ESK70-1212	+5V 7A	+12V 1.5A	-12V 1.5A
ESK80-1212	+5V 10A	+12V 1A	-12V 1A

VOLGEN
PRODUCTS

- * WORLD LEADER in AC/DC
- PSN(100 VAC IN-SINGLE OUT:15,25,50,100,150watts)
- PSK(100 VAC IN-DUAL & TRIPLE OUT:15,30,50,70,80watts)
- ES (100/200 VAC IN-SINGLE OUT:15,25,50,100,150watts)
- ESK(100/200 VAC IN-DUAL & TRIPLE OUT:20,30,50,70,80watts)
- MP3(100VAC IN-SINGLE OUT:3watts-ENCAPSULATED TYPE)
- * PIONEER in DC/DC
- EP (5/12/24 VDC IN-SINGLE OUT:10watts)
- DX (12/24/48 VDC IN-SINGLE OUT:15,25,50,100,150watts)



HIGH SPEED SWITCHING POWER SUPPLY:100KHz

VOLGEN ELECTRIC CO., LTD.

Head Office:

4-12-5 Meguro Meguro-Ku Tokyo 153 Japan

PHONE: (03)715-3125, 710-5521

FACSIMILE: (03)710-5601

PLEASE CONTACT THE REPRESENTATIVE LISTED BELOW IN THE UNITED STATES, CANADA AND THE UNITED KINGDOM.

U.S.A.:

KSC ELECTRONICS, INC

543 WEST ALGONQUIN ROAD ARLINGTON HEIGHTS
ILL. 60005 USA
PHONE: (312)981-5600
TELEX: (W/U)028-2438, 025-4306

CANADA:

KANEMATSU GOSHO INC-TRONTO

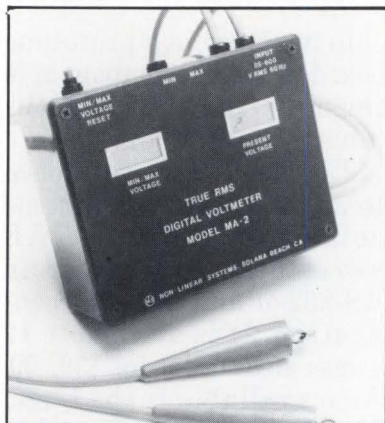
188 UNIVERSITY AVENUE 4th Floor, Tronto, Ontario,
Canada, M5H 3C3
PHONE: (416)593-5333 · 5339
TELEX: 6219522 CABLE ADD: KANEGOLD

U.K.:

TECHNITRON LTD

Doman Road, Yorktown Industrial Estate, Camberley,
Surrey GU15 3DH.
PHONE: Camberly 26517
TELEX: 858618

INSTRUMENTS

DVM derives power from measured source

Measuring line voltages of 110, 220, or 440 V ac, the MA-2 digital voltmeter is powered directly by the line source rather than by batteries. It operates over the

range of 85 to 600 V ac rms, and its accuracy of $1/2$ -V ac rms is not dependent on the purity of the waveform being measured. The meter provides an instantaneous LCD readout of voltage, as well as a track-and-hold display.

Non-Linear Systems, 533 Stevens Ave., Solana Beach, Calif. 92075; (619) 481-3953. \$380.

CIRCLE 352

DMM offers choice of three interfaces

The M 2110, a low-cost 30,000-count digital multimeter, is available with an IEEE-488, an RS-232-C, or a Centronics-type parallel in-

terface. The $4\frac{3}{4}$ -digit DMM offers a resolution equivalent to that of $5\frac{1}{2}$ -digit meters over a large part of its measuring range. The M 2110 measures dc and ac voltage up to 1000 V, dc and ac current up to 20 A (30 A for 10 seconds), and resistance up to 20 M Ω . Basic dc accuracy is within $\pm 0.05\%$ +1 digit; basic ac accuracy is within $\pm 0.25\%$ +20 digits.

BBC-Metrawatt/Goerz, 6901 W. 117th Ave., Broomfield, Colo. 80020; (800) 821-6327 or (303) 469-5231. \$685; stock.

CIRCLE 353

Emulator board develops 6805 programs

Intended for use with the IBM PC, a board-level emulator provides complete development support for the 6805 family of microprocessors. The system, called the Micro-Aid/05A, comprises a 6805 cross assembler, an in-circuit emulator, a symbolic debugger, and an EPROM programmer.

The emulator hardware includes 8 kbytes of overlay RAM and supports up to eight real-time breakpoints. The basic Micro-Aid system emulates the MC146805E2 microprocessor, with an optional interface pod available for 14 types of single-chip 6805 microcomputers.

Thorson Engineering Co., 6225 76th St. SE, Snohomish, Wash. 98290; (206) 334-4214. \$1200 and \$250 for the emulator and interface pod, respectively (unit quantities).

CIRCLE 354

Destination: everywhere.

Our custom power supplies make your product a world-class traveler. VDE, BPO, UL, CSA—we meet them all.

At last: you don't have to be tied up with "customs" any more! We design power supplies quickly and cost-effectively to meet your critical specifications.

Call us today and ask about our non-stop service. We'll write you a passport to international success.



2111 Howell Avenue
Anaheim, California 92806
(714) 937-1301 • TWX: 910-591-1983

© Copyright 1984, National Power Technology



Specifications:
65-500 watts
Single- and multiple-output
Overload and overvoltage protection
Remote sense on main outputs
Standard models also available;
call for details.

CIRCLE 622

"See us at WESCON, booth numbers 3024-3025, 3124-3125."

INSTRUMENTS

Pen-size logic pulser clips onto pocket

Designed to clip onto a shirt pocket, a multimode logic pulser tests RTL, DTL, TTL, and MOS integrated circuits and microprocessors without having to desolder pins or cut printed circuit traces. Designated the PLS-1, the small device superimposes a single 20- μ s pulse or a dynamic pulse train (20 pulses/s) directly onto a circuit node, even when it is being clamped by a digital output. Pulse polarity is automatic; high nodes are pulsed low and low nodes are pulsed high. The logic pulser can also source or sink enough current

to force saturated output transistors into the opposite logic state. Featuring an input impedance of 1 M Ω , the PLS-1 also offers input over-voltage protection to within ± 50 V and power lead reversal protection.

OK Industries Inc., 3455 Conner St., Bronx, N.Y. 10475; (212) 994-6600. \$67.60; stock.

CIRCLE 355

80-W rf amplifier spans 200 to 1000 MHz

The latest addition to the ultrabroadband W series, the fully solid-state Model 80W1000M1 produces a minimum output of 80 W through-

out a bandwidth of 200 to 900 MHz and 70 W minimum out to 1000 MHz. The amplifier's minimum continuous-wave linear output (less than 1 dB of gain compression into 50 Ω) is 50 W from 200 to 1000 MHz.

The unit supplies a minimum gain of 48 dB with a flat response of ± 1.5 dB typical and ± 2 dB maximum. Harmonic distortion is no less than 20 dB below fundamental at an output of 50 W and intermodulation distortion, specified by the third-order intercept, is typically 50 dBm.

Amplifier Research, 160 School House Road, Souderston, Pa. 18964; (215) 723-8181. \$36,000; 60 to 90 days.

CIRCLE 356

SPACE SAVER!

Reliability's 1-WATT DC-DC CONVERTERS



- V-PAC®**
- ① 24-pin package
 - ① High MTBF
 - ① Short circuit protected
 - ① Mechanically and electrically keyed
- S-PAC™**
- ① 7-pin SIP package
 - ① Size: .550" x 1.25" x .33"
 - ① Thermal overload protected
 - ① Minimum 200VDC isolation, 10⁹ Ω

These units operate from an input of 5VDC or 12VDC and make available at board level a wide range of isolated, regulated or unregulated, single or dual output voltages.*

Operating temperature range is -25°C to $+70^{\circ}\text{C}$.

*Dual regulated not available in S-PAC

RELIABILITY INCORPORATED POWER SOURCES DIVISION

PO. BOX 218370, HOUSTON, TX 77218
PHONE: (713) 492-0550/TLX: 910-881-1739

EUROPE: RELIABILITY NEDERLAND BV
REPUBLIC OF IRELAND
PHONE: 067-31897
TLX: 852-26833

Quality is Reliability



CIRCLE 623

Standard to the Industry Since 1946 RFI/EMC Filters



POWERLINE® FILTERS for high power installations, shielded rooms, communication centers, security areas. Currents from 5 to 2,000 Amperes.

FIL-TEL® FILTERS for secure communication lines, telephone lines and signal lines in Red/Black and Tempest installations.

SUB-MINIATURE FILTERS for your miniaturized electronic equipment, FILTRON manufactures a complete line of microminiature RF filters.

CUSTOM FILTERS over 30,000 designs available in a wide variety of voltage and current ratings, mounting and terminal configurations — or custom engineered to meet specific customer requirements.

FILTERED CIRCUIT BREAKER PANEL BOARDS for secure communication installations.

TESTING AND CONSULTATION SERVICES for customized products and systems to meet such requirements as Red/Black, Tempest, EMP, EMC, EMI, FCC, etc.

FILTRON®
FILTRON CO., INC., Subsidiary of Aeroflex Laboratories Inc.
148 Sweet Hollow Road, Old Bethpage, NY 11804 • (516) 752-1144



CIRCLE 624

COMPONENTS

Surface-mounting resistor array provides flexibility

One of the first resistor array families with leads designed for surface mounting can be con-

figured in a variety of configurations, with various values, numbers of resistors, and package sizes.

For space-sensitive applications, the Series 800 SARA package from Allen-Bradley can be specified for standard small-outline or regular DIP sizes, as well as custom sizes. Standard pin counts are 8, 14, and 16. The standard packages are suitable for automatic placement.

The number of resistors varies widely. The resistors, which can be laser-trimmed by the user, are built on a common ceramic substrate with thick-film resistive materials.

The family can be mounted on various board types, including epoxy-glass, porcelainized metal, or ceramic. The package features a protective coating that withstands both cleaning and solder reflow processes.

Resistance ranges from $10\ \Omega$ to $10\ \text{M}\Omega$, with power dissipation of 125 mW per resistor at 70°C . The standard temperature coefficient of resistance is $\pm 200\ \text{ppm}/^\circ\text{C}$, and $100\ \text{ppm}/^\circ\text{C}$ is also available; standard TCR tracking is $\pm 100\ \text{ppm}/^\circ\text{C}$, with $50\ \text{ppm}/^\circ\text{C}$ available.

Pricing will vary widely depending on the number of resistors and their values, but typical packages should cost less than 50¢ apiece in volume quantities, which require about 10 weeks for delivery.

Allen-Bradley Co., Electronics Group Marketing Communications, 1201 South Second Ave., Milwaukee, Wis. 53204; (414) 671-2000.

CIRCLE 301

Schaffner EMC filters...we make them better, so we can make this offer:

Buy a competitor's EMC filter and you may find a third of all those you test before installation not functioning up to spec. Sure they'll be replaced, but can you afford the delay? Sloppy soldering, opens, and hipot failures can cause problems you need not encounter.

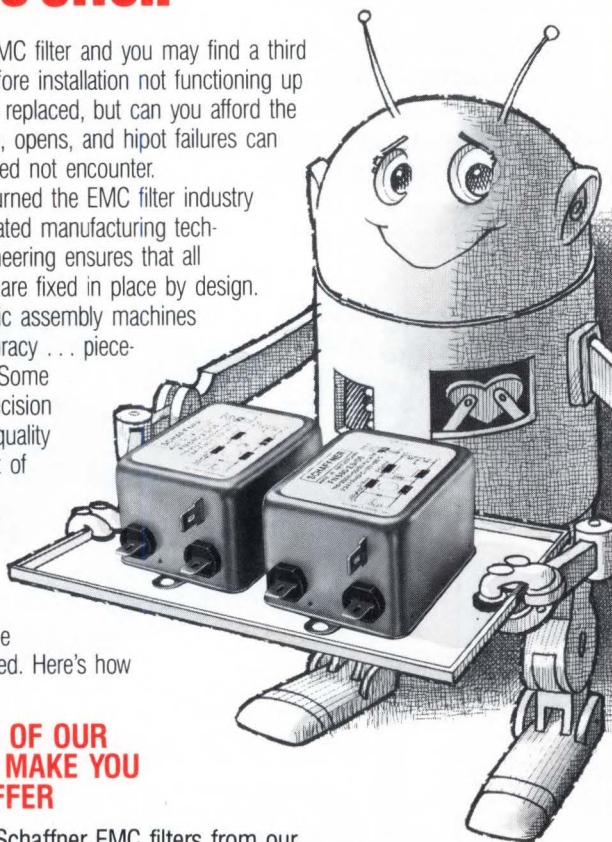
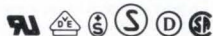
At Schaffner, we've turned the EMC filter industry around with our automated manufacturing techniques. Advanced engineering ensures that all components and leads are fixed in place by design. What's more, our robotic assembly machines adhere to pinpoint accuracy... piece-after-piece, after piece. Some call this attention to precision fanatical... we call it quality... and it's at the heart of every filter we make.

Schaffner EMC filters meet international safety agency standards, are competitively priced, delivered on time and perform as promised. Here's how we prove it.

WE'RE SO SURE OF OUR QUALITY, WE'LL MAKE YOU THIS 2 FOR 1 OFFER

Order at least 1,000 Schaffner EMC filters from our wide selection, and for any one found to be defective, we'll send you two in return.* We're not trying to make a deal... just make a point. Schaffner EMC filters are better by design. We promise... and we deliver.

*Contact Schaffner for details and disclaimer. Offer may be withdrawn at any time.


SCHAFFNER


• RFI Suppression Filters • EMC Test Equipment • Test and Application Services
 USA: Schaffner EMC, Inc., 825 Lehigh Ave., Union NJ 07083/(201) 851-0644
 Switzerland: Schaffner Elektronik AG, CH-4708 Luterbach, Switzerland/Telefon 065 4231 31

CIRCLE 625

COMPONENTS

Liquid-crystal display rivals CRT performance

Using a 5-by-7-dot matrix, the F641D liquid-crystal display produces 25 lines of 80 characters each—as much information as a standard CRT display. Additionally, the F641D display offers advantages such as smaller size, lower weight, lower power consumption (only 200 mW), and a single +5-V supply requirement.

To simplify connection to other devices, the display incorporates interface circuitry that reduces the data input signals to two lines, which also allows it to run at a high data-transfer rate. A temperature-compensation circuit ensures good contrast over an operating range of 0° to +50°C. The 0.51-in.-thick display package has outside dimensions of 11.81 in. wide by 5.75 in. high.

Seiko Instruments, 2990 W. Lomita Blvd., Torrance, Calif. 90505; (213) 530-8777. \$410 (100 units); stock. **CIRCLE 357**

Jumper resistor has 0.01-Ω resistance

For circuits requiring low-resistance interconnections, a jumper resistor has a minimum current rating of 10 A and a maximum resistance of 0.01 Ω. Designated the type FRJ-55, the resistor is designed to operate over the temperature range of -55° to +165°C. The device has the same basic size as a standard 1/4-W metal-film resistor and is compatible with automatic

insertion equipment. For ease of identification after mounting, the FRJ-55 resistor is marked with a single black color band. In quantities of one million, the jumper resistor sells for \$0.0145 each

and is available in industry-standard tape-and-reel packaging.

Dale Electronics Inc., 2300 Riverside Blvd., Norfolk, Neb. 68701; (402) 371-0080.

CIRCLE 358

**Established Reliability
MIL Approved**

S102K SERIES RESISTOR

(NOW OBSOLETES S102C SERIES RESISTOR)

Bulk Metal® Foil Resistors with greatly improved performance and NO increase in price

Resistance Versus Temperature Curves

Y-axis: $\frac{\Delta R}{R}$ (PPM) from -200 to +200
X-axis: TEMPERATURE °C from -55 to +125

Curves shown: S102K (New) and S102C (Original)

**1ppm/°C
MIL Range
(-55°C to +125°C)**

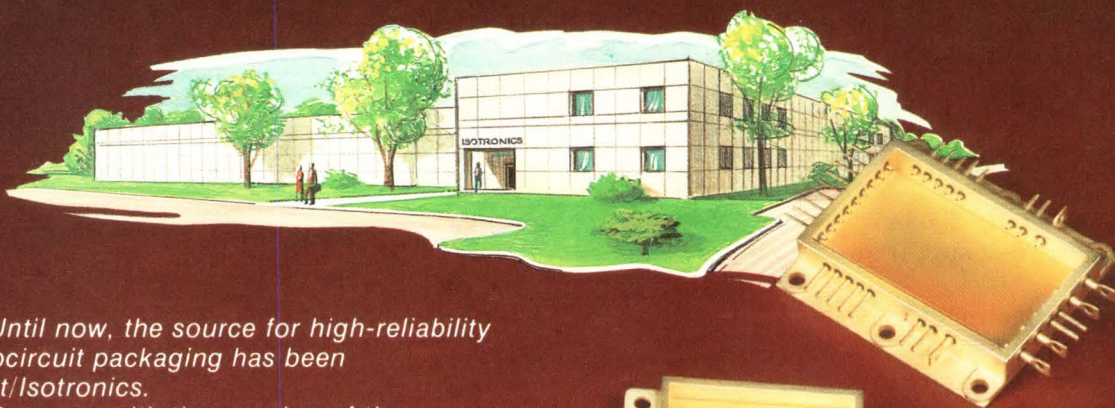
**TCR (nominal)
0.3ppm/°C
Instrument Range
(0°C to +60°C)**

"Another major advance from the inventors of foil resistor technology."

For more information about other improved specifications of the S102K write to:
Vishay Resistive Systems Group
of Vishay Intertechnology, Inc.,
63 Lincoln Highway, Malvern, PA 19355
(215) 644-1300; TWX 510-668-5812

VISHAY
...to be precise®

Now you have a **SECOND SOURCE** for High-Rel All-Metal Packaging Just as Good as **AUGAT[®] Isotronics[®]**



Until now, the source for high-reliability microcircuit packaging has been Augat/Isotronics.

But now, with the opening of the Augat/Isotronics-Texas, your primary source becomes your second source, too . . . producing the industry's most reliable all-metal hybrid microcircuit packages, just as we've been doing in Massachusetts for more than 20 years.

Our new 45,000-square-foot production facility in San Antonio, Texas, combined with our existing plants in New Bedford, Mass., and Saddle Brook, N.J., more than doubles our capacity.

Located in University Park, this state-of-the-art, automated plant is your second source for high-reliability microcircuit packages, offering the same meticulous quality control and inspection standards, meeting the most stringent military and aerospace specifications, as your primary source.

Because they're both Augat/Isotronics . . . the inventors of quality all-metal packaging, and the innovators of every major development in all-metal packaging since 1962.

Now...

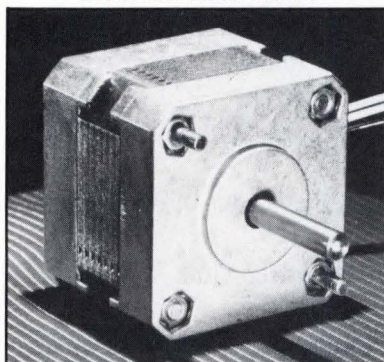
AUGAT[®] Isotronics[®]/Texas

Second Source/Primary Source

Industrial Park, New Bedford, MA 02745
(617)998-2000 TWX 710 344 1961 Cable-Isotronics

CIRCLE 627

COMPONENTS

**Hybrid stepper
boasts low cost**

Priced at only \$10.95 in quantities of 500, a hybrid 1.8° stepping motor offers designers of computer peripherals and instrumentation a good cost-to-performance ratio for accurate rotary positioning. The Series 4SQ motor, which operates from 12 V dc, features a holding torque of 9.2 oz-in. and a running torque of up to 45 oz-in. Utilizing an L/4R drive, the motor can reach speeds in excess of 3200 steps/s. Typical applications for the 4SQ include read/write head positioning in disk and tape drives.

Airpax Corp., Cheshire Industrial Park, P.O. Box 868, Cheshire, Conn. 06401; (203) 272-0301. Two to four weeks (prototypes).

CIRCLE 359

**UHF transistor employs
push-pull design**

Consisting of two transistor dice in one package—with independent base and collector leads and common emitters—the MRF390 UHF transistor is capable of operating as an rf push-pull amplifier. The 28-V device, designed for use in commercial

and military avionics radios, also eases amplifier design because it requires less space and is less expensive than two single transistors. The component delivers 60 W in the 30-to-500-MHz frequency range and produces a typical gain of 9.5 dB at an efficiency of 55%. Long-term device reliability is ensured through gold metallization.

Motorola Semiconductor Products Inc., PO Box 20912, Phoenix, Ariz. 85036; (602) 244-6069. \$60 (100 units).

CIRCLE 360

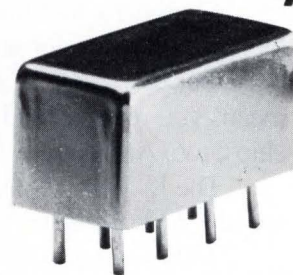
**Compact pcb relays
offer mounting options**

Two space-saving families of pc board relays are available in different mounting styles, making them suitable for a broad range of commercial and consumer products. The Model G3L solid-state relay is for sensitive 2-A switching of 12- or 24-V dc inputs to an ac output. The G5D power relay is designed for high-capacity 30-A single-pole or 20-A double-pole switching of ac and dc loads.

In packages as thin as 0.39 in., the G3L offers a choice of either a 1.18-in.-tall vertical or a low-profile 0.78-in. horizontal type. The G5D power series is available in 6-240-V ac and 6-110-V dc versions in top-mounted or E-bracket configurations.

Omron Electronics Inc., 1 E. Commerce Drive, PO Box 4066, Schaumburg, Ill. 60195; (312) 843-7900. From \$8 (G3L) and \$7.50 (G5D).

CIRCLE 361

**power
splitter/
combiners****2 way 0°**

**0.1 to 400 MHz
only \$9⁹⁵ (6-49)**

IN STOCK... IMMEDIATE DELIVERY

- MIL-P-23971/15-01 performance*
- NSN 5820-00-548-0739
- miniature 0.4 x 0.8 x 0.4 in.
- hermetically-sealed
- low insertion loss, 0.6dB
- hi-isolation, 25dB
- excellent phase and amplitude balance
- 1 year guarantee

*Units are not QPL listed

PSC-2-1 SPECIFICATIONS

FREQUENCY (MHz) 0.1-400

INSERTION LOSS, above 3dB		TYP.	MAX.
0.1-100 MHz		0.2	0.6
100-200 MHz		0.4	0.75
200-400 MHz		0.6	1.0
ISOLATION, dB	25dB	TYP.	
AMPLITUDE UNBAL.	0.2dB	TYP.	
PHASE UNBAL.	2°	TYP.	
IMPEDANCE	50 ohms.		

For complete specifications and performance curves refer to the Microwaves Product Data Director, the Goldbook, EEM, or Mini-Circuits catalog

finding new ways...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
2625 E. 14th St. B'klyn, N.Y. 11235 (718) 769-0200

C73-3 REV. B

CIRCLE 628

Microbar's K-2 family takes the "what ifs" out of designing your next system.

In the SBC business, playing "wait and see" simply doesn't make for leadership. It doesn't make market leaders out of OEMs and system integrators, either. What's needed is foresight—for prudent planning. And flexibility—for fast response to change.

Microbar's K-2 family of Multibus™-based SBCs demonstrates the idea. They're a pure example of look-ahead, ready-for-anything design—the kind of design that can add "front runner" to your reputation.

Our new **LBX+™ boards**, for example, meet and exceed the LBX standard. The "+," by the way, means you're prepared for either **16- or 32-bit data transfer**. And the LBX+ boards use the **256K RAM** chips, too. And feature 10- or 12-MHz speeds.

The K-2 family also has **expansion modules** that easily take you to two megabytes of on-board high-speed RAM. Or up to one megabyte with **ECC**, if you like.

There's a lot more. **Memory management modules**, for instance. That offer the Unix™-oriented **two-level paging**. And that make implementing the 68010 virtual memory a snap.

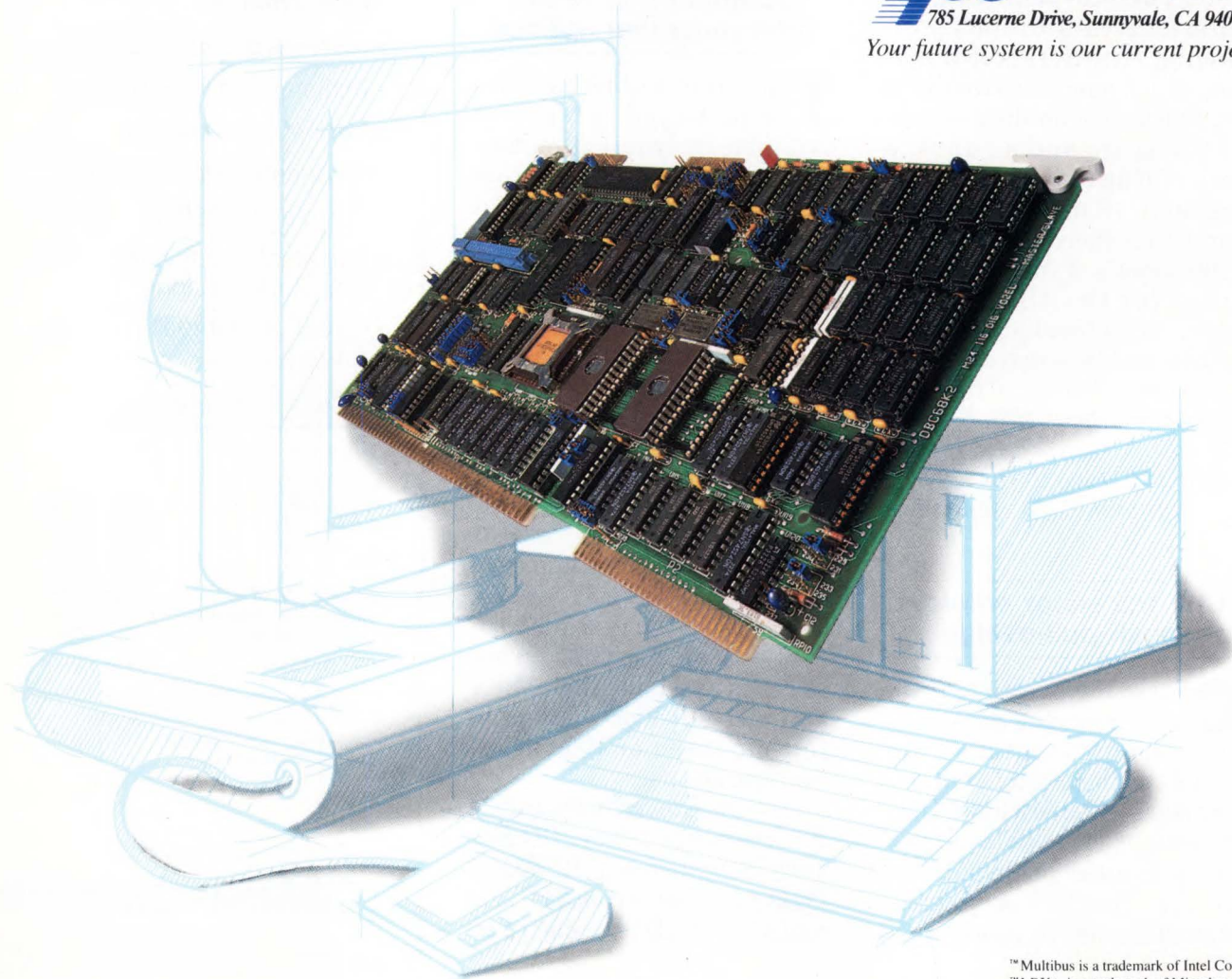
No doubt. The K-2 family reflects thinking that puts "what if" worries to rest. Of course, looking forward—objectively—is a Microbar tradition. We do it well because we're independent. And because **SBC's are our only business**. That's what keeps us ahead. That's what keeps you ahead. Better write—or phone toll-free—and find out more. Now.

Within California: (800) 421-1752

Outside California (continental U.S.): (800) 821-1011

 **MICROBAR
SYSTEMS, INC.**
785 Lucerne Drive, Sunnyvale, CA 94086

Your future system is our current project.



™ Multibus is a trademark of Intel Corp.
™ LBX+ is a trademark of Microbar Systems, Inc.
™ Unix is a trademark of Bell Laboratories, Inc.

FACTORY AUTOMATION

Interface unit accepts multitude of sensors

A modular interface unit that handles inputs from many types of sensors lets users build basic systems or add sensors without designing custom interfaces for each sensor type. The SID-2000 from Micro Switch can operate with sensors for proximity, pressure, current, and heat, as well as Hall-effect sensors, fiber-optic switches and programmable pushbuttons. It puts out signals to programmable controllers, personal computers, and other hosts.

The system consists of a CPU module, a status link,



and a number of interface modules. The CPU, built around a Z8 processor, features 2 kbytes of EEPROM. It

can monitor up to 160 external inputs and outputs and can be programmed with a hand-held unit.

The status link manages communications from sensor to host. Various interface modules handle specific types of signals; included in these modules are a-d converters and multiplexers.

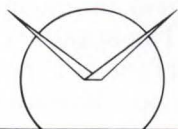
A typical configuration costs about \$1500. The programmer lists for \$495. Delivery takes about six weeks.

Micro Switch, a Honeywell division, 11 West Spring St., Freeport, Ill. 61032; (815) 235-6600.

CIRCLE 303

PSPICE

**ELECTRICAL CIRCUIT SIMULATOR
For the IBM PC**



- AC, DC, and Transient Analysis
- Up to 120 Transistors per Circuit
- 1/5 speed of VAX 11/780
- \$950 (quantity one)

MICROSIM CORPORATION

14101 Yorba Street, Suite 202 • Tustin, CA 92680 • (714) 731-8091

VAX is a registered trademark of Digital Equipment Corporation

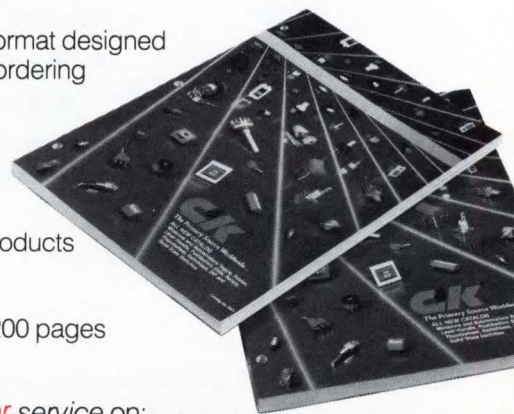
CIRCLE 630

C&K's New Catalog Makes It Easier To Order Switches!

- New format designed for easy ordering

- Many new and exciting switch products

- Over 200 pages



For *faster* service on:
Catalog or Distributor Locations
Call 1-800-243-8160
(in CT call 1-800-842-0225)
Technical information (617) 964-6400



C&K Components, Inc.
15 Riverdale Avenue, Newton, MA 02158
Twx: 710-335-1163 Telex: 92-2544

The Primary Source Worldwide...

CIRCLE 631

FACTORY AUTOMATION

System talks to process controllers

Designed to bring personal computing to the factory floor, the FactoryCalc system utilizes real-time production,

diagnostic, and management data from programmable controllers to provide a real-time window into process and machine control systems. The combination hardware/software package, which works

with the IBM PC, interfaces with all major brands of controllers and enables screen displays and report formats to be configured without programming. The system's information manager, a stand-alone data acquisition device, contains a real-time clock in order to retrieve data on a regular and predetermined basis. The unit supports both RS-232-C and RS-422 communications at 300 to 9600 bauds.

MISA Corp., 100 Techcenter Drive, Milford, Ohio 45150; (513) 831-4944.

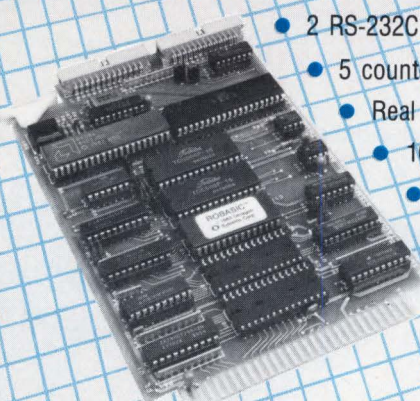
CIRCLE 362

The STD Bus Language: ROBASIC™

FAST - ROBASIC is a ROM-based language that runs up to 50 times faster than Basic, without compiling. **With ROBASIC, you may never need Assembly Code again!**

EASY - ROBASIC is easy like Basic. But with multi-tasking plus special measurement and control commands. Because ROBASIC is part of an integrated hardware/software system, it replaces expensive development systems. ROBASIC makes everyone a programmer.

ROBASIC - now on the Octagon 880 Multifunction CPU card.



- 2 RS-232C serial ports
- 5 counter/timers
- Real time clock
- 16 parallel I/O channels
- 9 prioritized interrupts
- 8088 processor - IBM-PC compatible
- ROBASIC on board in 16K ROM

ROBASIC and the 880 give you a powerful tool for real time control. Connect a 5V supply and a CRT or personal computer and write ROBASIC programs the same day - guaranteed.

Hardware and software products and support are available.

CALL Robert Schlesinger for details: (303) 426-9780



OCTAGON SYSTEMS CORPORATION
6501 W 91st Ave., Westminster, Co. 80030 (303) 426-8540

CIRCLE 632

Operator interface talks with controllers

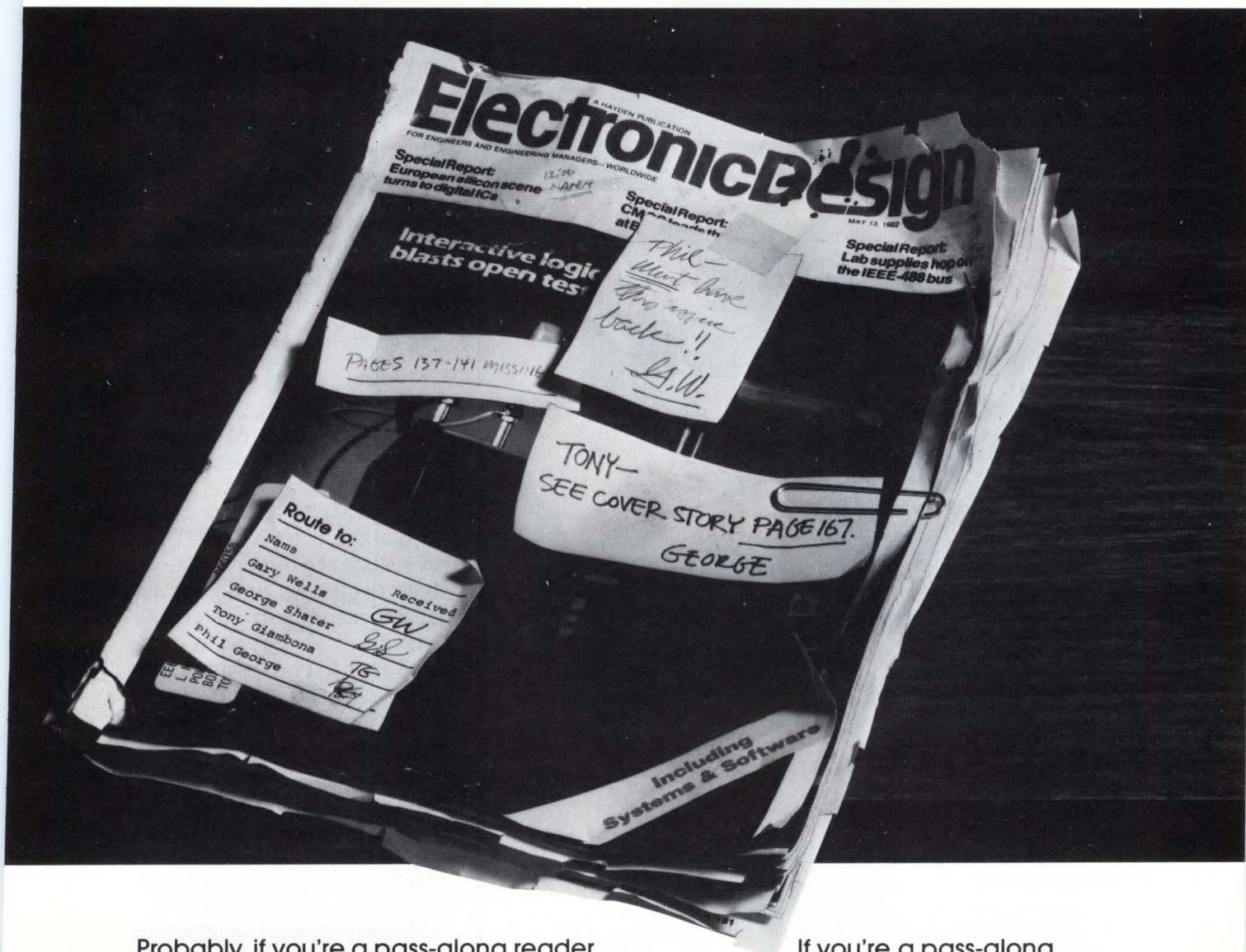
Linking the programmable controller with its human operator is the Metra 2001 communications interface. The system comprises an interface controller and a 13- or 19-in. color graphics monitor, which displays process information in real-time. The multitasking firmware prioritizes critical tasks such as alarm annunciation.

The standard operator interface controller has four serial communications ports for direct connection with programmable controllers or data highways using the same protocol. The 48-key sealed membrane keyboard, which is designed for industrial environments, has 16 soft keys for making rapid changes to process parameters.

Metra Instruments Inc., 2056 Bering Drive, San Jose, Calif. 95131; (408) 297-8530. From \$7990.

CIRCLE 363

Does your copy of **ElectronicDesign** ever look like this?



Probably, if you're a pass-along reader. Which means you're getting the latest new technology information secondhand.

Take our cover stories, for example. Each cover story delivers the first design details of an important new product or technology being announced exclusively in *Electronic Design*.

Or a major staff-written report, followed by a comprehensive package of related articles by-lined by leading authorities at important design centers.

If you're a pass-along reader, why not be second to none? By subscribing to *Electronic Design*, you'll receive 26 issues of the latest new technology, products, and applications. Every time. On time.

There's a subscription card bound in this issue. Send it in today. Because the time it takes other readers of your next copy to sift through and evaluate the latest industry breakthroughs may be all the time your competitors need.

FACTORY AUTOMATION

**Position controller
is accurate, flexible**

The Series 6000 is a servo control system whose performance is accurate to within 2%. Three standard inputs

are available—0 to 5 V, 4 to 20 mA, and 8-bit digital—to accommodate a variety of applications, such as process control or isolated digital-to-analog conversion. Designed for chassis mounting, the sys-

tem offers built-in feedback, LED status indicators, and a regulated 115-V ac power supply. A full range of motorized potentiometers is available with a large selection of output rpms. Additionally, the potentiometer may be removed from the board and operated remotely.

ETI Systems, 215 Via Del Norte, Oceanside, Calif. 92054; (619) 757-7770.

CIRCLE 364

\$1850**THE IBEX
MAINSTREAMER™**

**At \$1850* the price is the
least of the breakthroughs!**

This IBM format-compatible 9-track tape drive weighs 60% less than any equivalent system available. And occupies 25% less space. (Save up to \$200 on freight costs alone!). It's simple and reliable. Fewer moving parts. No automatic threading failures. No noisy blower. And look at all you get:

- Storage of up to 136M bytes per reel
- Transfer rates of 20K to 160K bytes / second
- 800 bpi NRZI, 1600 and 3200 bpi PE
- Cipher / Pertec interface
- Internal diagnostics
- Mounting options: Door, Drawer or Table Top

The IBEX MAINSTREAMER. **Right for the times.**

Call, TWX or write today for the rest of the story. And for the telephone number of the sales office nearest you.

*OEM quantities, 1600 bpi PE format, domestic prices.

Phoenix: ASR-NM, (602) 949-8293 • Los Angeles: Gemini Associates, (213) 594-9618 • Rochester, NY: Ossman Group, (716) 424-4460 • San Jose: Reptek - No. Calif., (408) 947-0622 • Chicago: SEA, Inc., (317) 846-2591 • Washington, D.C.: Scott Data Corp., (703) 765-7901 • Orlando: Southeast Data Prod., (305) 788-3666 • Union, NJ: Stearns Associates, (201) 686-2980 • Boston: Sturdy Corp., (617) 235-2330 • Dayton: Swenson Associates, (513) 866-3233 • Dallas: Thorson Company, (214) 233-5744

IBEX

Right for the times

CIRCLE 634

**Rugged RTD delivers
fast, accurate response**

Accurate to within $\pm 0.1^\circ$ at 0°C , the ARiDET line of resistance temperature detectors offers a time constant of 2.2 seconds or less (measured in water at a flow rate of 3 ft/s). The mineral-insulated RTDs operate over a temperature range of -200° to $+600^\circ\text{C}$ and are designed to withstand vibration and shock— $\pm 50\text{ G}$ from 60 to 2000 Hz and up to 1000 G in all three axes, respectively. The rugged construction of the detector maintains its $\pm 0.05^\circ\text{C}$ calibration in the toughest industrial process.

The probes come with a 100- Ω platinum element, specified to the DIN 43760 or the high-purity JIS C-1604-81 temperature-vs-resistance curve. The device is stocked in a basic unit for direct attachment of lead wires or connectors. It is also available with a 4-to-20-mA transmitter.

ARi Industries Inc., 381 ARi Court, Addison, Ill. 60101; (800) 237-6725 or (312) 953-9100.

CIRCLE 365

Circuit-Board-Design Without the Tedium

smARTWORK™ lets the design engineer create and revise printed-circuit-board artwork on the IBM Personal Computer.

Forget tape. Forget ruling. Forget waiting for a technician, draftsman, or the CAD department to get to your project. smARTWORK™ software turns your IBM Personal Computer into a professional, high-quality drafting tool. It gives you complete control over your circuit-board artwork — from start to finish.

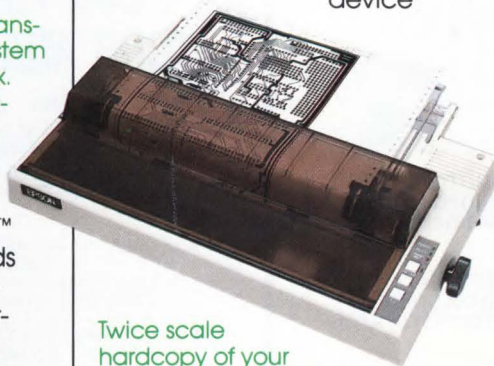


smARTWORK™ transforms your IBM PC into a CAD system for printed-circuit-board artwork. Display modes include both single-layer black and white and dual-layer color.

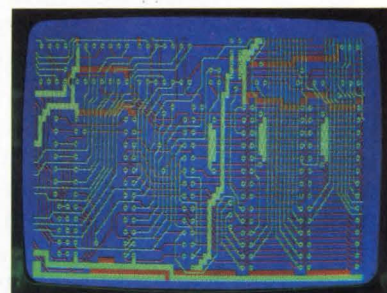
What makes smARTWORK™ so smart is that it understands electrical connections. Conductor spacing is always correct, lines don't become too narrow, and connecting lines do not intersect other conductors. smARTWORK™ can automatically find and draw the shortest route between two conductors. Or you can specify the route.

smARTWORK™ is the only low-cost printed-circuit-board artwork editor with all these important advantages:

- ☐ Complete interactive control over placement and routing
- ☐ Quick correction and revision
- ☐ Production-quality 2X artwork from pen-and-ink plotter
- ☐ Prototype-quality 2X artwork from dot-matrix printer
- ☐ Easy to learn and operate, yet capable of sophisticated layouts
- ☐ Single-sided and double-sided printed-circuit boards up to 10 x 16 inches
- ☐ Multicolor or black-and-white display
- ☐ 32 user selectable color combinations; coincident points can be displayed in contrasting colors.
- ☐ Can use optional Microsoft Mouse as pointing device



Twice scale hardcopy of your artwork is produced using the Epson dot-matrix printers or the Houston Instrument DMP-41 pen-and-ink plotter. Quick 1X check plot is also available from Epson printers.



Dual-layer color display of a 2" by 4" section of a 10" by 16" circuit board

The Smart Buy

At \$895, smARTWORK™ is an exceptional value, particularly when compared to conventional engineering workstation costs.

Call or write us for more information on smARTWORK™. We'll be glad to tell you how smARTWORK™ helps us design our own circuit boards and what it can do for your business.

Send a purchase order, or major credit card number, and smARTWORK™ can be working for you next week.

System Requirements

- ☐ IBM PC or XT with 192K RAM, 2 disk drives and DOS Version 2.0
- ☐ IBM Color/Graphics Adapter with RGB color or b&w monitor
- ☐ Epson MX-80/MX-100 or FX-80/FX-100 dot-matrix printer
- ☐ Houston Instrument DMP-41 pen-and-ink plotter (optional)
- ☐ Microsoft Mouse (optional)



"smARTWORK" and "Wintek" are trademarks of Wintek Corporation.

SOFTWARE

Technical data base aids product searches

Through a combination of software and database design, engineers have available for the first time an electronic catalogue of components, as well as parametric data to speed evaluation. The system, implemented by VideoLog Communications, consists of a large data base and a database manager residing in the company's host system, plus a software package that will turn any IBM personal computer (or compatible machine) into a videotex terminal capable of decoding the NAPLPS (North American

Presentation Level Protocol Syntax) graphics data.

The PC must be equipped with a graphics card, a color monitor, and at least one floppy-disk drive, or any other NAPLPS-compatible system can be used.

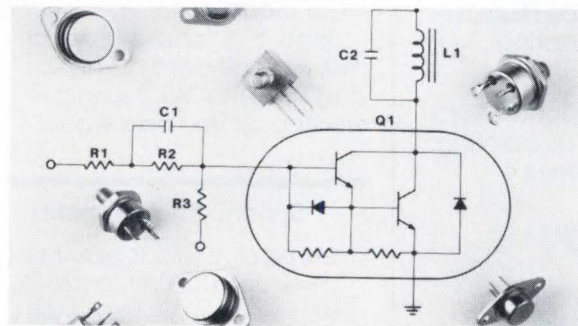
The host system, which contains more than half a million device types on file, will have, on line, catalogue information from many semiconductor and eventually component vendors. Database searches can cover up to 15 parameters on more than 1000 distinct semiconductor types.

To access the data base, a user would just log onto the system using a PC and the VideoLogON software, which will be available for \$150 on a floppy disk. The price includes a manual, telephone access numbers, and a user ID code. Usage charges for the data base and for parametric search activities start at \$15/hour and \$39/hour, respectively. Also, VideoLog is offering a demonstration disk as an evaluation tool.

VideoLog Communications, 50 Washington St., Norwalk, Conn. 06854; (203) 838-5100.

CIRCLE 309

HIGH REL POWER TRANSISTORS



Teledyne Crystalonics offers a line of high reliability power transistors and darlington transistors designed to meet aerospace screening and burn-in requirements assuring performance and delivery.

The transistors are processed in our new wafer fab clean rooms using the latest processing techniques and equipment with state-of-the-art process controls and monitoring.

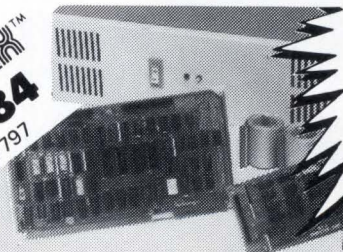
Geometries currently in production cover NPN/PNP complementary transistors and darlington transistors with ratings from 3 to 50 Amps and 80 to 500 Volts. Some standard types are 2N6282-2N6287, 2N5329, 2N5330, 2N6274 to 2N6277, 2N6032, 2N6033, 2N6278 to 2N6281, 2N6377 to 2N6379, 2N5678, 2N6350 to 2N6353, 2N3867, 2N3868, 2N3719, 2N3720, 2N6303, 2N3766, 2N3767.

TELEDYNE CRYSTALONICS

147 Sherman Street, Cambridge, MA 02140
Tel (617) 491-1670, TWX 710-320-1196

CIRCLE 645

See us at
COMDEX
Fall '84
Booth 797



**NEW
16-BIT
OPTION**

PLUG THE IBM PC INTO YOUR MULTIBUS CHASSIS

MULTIBUS USERS: You now have the full resources of the IBM PC or PC XT to use in your MULTIBUS system. The processing power of the PC coupled with its peripheral I/O and extensive software support makes it an excellent choice as the master processor or co-processor in your MULTIBUS application.

- Use the PC MACRO ASSEMBLER and PC DOS debug facilities to develop and test your MULTIBUS software.
- An 8K dual port concurrent access static RAM serves as a DMA buffer or as additional PC or MULTIBUS memory.
- Directly address MULTIBUS memory as though it were PC memory.
- Directly address MULTIBUS I/O cards as though they were PC I/O cards.
- A desk top MULTIBUS cabinet designed to match the styling of the IBM PC is available as an option.

Contact BIT 3 for details.

BIT 3

Manufacturers Reps
inquiries invited.

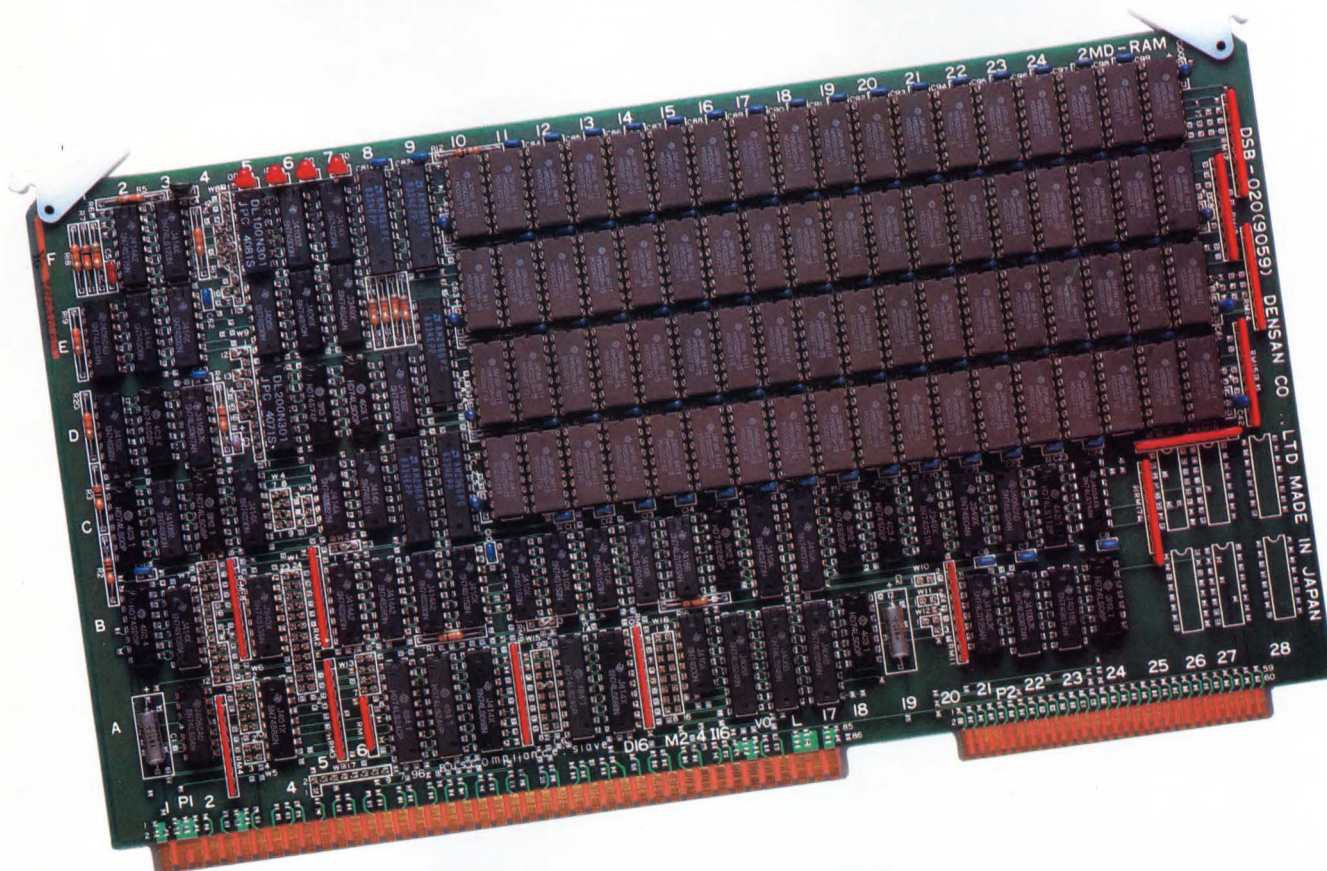
8120 PENN AVE. SOUTH
MINNEAPOLIS, MN 55431

IBM is a trademark of IBM Corp.

(612) 881-6955

CIRCLE 646

DENSAN'S MULTIBUS COMPATIBLE MEMORY BOARDS- TOP QUALITY AT A PRICE YOU CAN AFFORD!! UNMATCHED RELIABILITY AT ANY PRICE!!



512K $\Rightarrow$ 2M DYNAMIC RAM

- ★ IEEE-796/Multibus* Compatible
- ★ Selectable 8-bit or 16-bit read/write operations
- ★ Parity check and error status register
- ★ Four LED error flag indicators
- ★ Start address can be assigned at any 4K boundary within 16M-byte range
- ★ Provides four inhibited areas—two 32K blocks and two 64K blocks
- ★ Uses 150 ns standard chips
- ★ Outstanding access time of 240 ns (typical)

The **DSB-012** memory board from Densan gives you 512K bytes of fast memory for any 8- or 16-bit Multibus system. The typical access time of only 240 ns will squeeze the last drop of performance from your 8086, 68000 or Z8000 based system for the most demanding applications.

Of course byte parity checking is standard. If a parity error occurs, the DSB-012 identifies the error, indicates it on four onboard LEDs, and generates an interrupt.

In addition, board addresses can be started on any 4K boundary in the 16M-byte address space. The 24-bit address bus and selectable 8/16-bit data ensure the board's compatibility with any Multibus system.

The **DSB-020** is a 2M-byte memory board that incorporates all the advanced features described above. You can assign four 32K blocks and four 64K blocks in memory as inhibited areas.

For more information please contact:

DENSAN CO., LTD.

Meiwa Bldg., 1-23-11, Kamitakaido, Suginami-Ku, Tokyo 168 Japan

Phone: (03) 329-3871 Telex: 2324050 DENSAN J Fax: (03) 329-9266

USA: Pascot Inc. Phone: (714) 261-5220 Telex: 181092 PASCOT UD

EUROPE: Diamond Point International Inc. UK Phone: 0276-682348

HONG KONG: Chai Luk Computer Ltd. Phone: 5-751151

TAIWAN: Mitac Inc. Phone: (02) 7150940

* MULTIBUS is a trademark of Intel Corp.

DENSAN

DIP IT! IT'S SEALED.

This low cost PC board relay keeps
contaminants outside...reliability inside.

DIP IT: It's sealed against flux, wash, degreasers, detergents. Automatic wave soldering and cleaning operations won't—can't!—affect contact reliability.

SMOTHER IT: It's sealed against dust, dirt, grime for stable contact resistance—even when idle for long, long periods.

CHOKE IT: It's sealed against fumes, gasses, all adverse environments.

"Guardian-Gold": An environmentally sealed version of our 4PDT, 5 amp, AC or DC 1310 series relay you've learned to depend on. Now, made even *more* dependable for your most demanding applications. Solders right to PC board. Or, choose solder lug termination. Choice of mating sockets, too.

All at an astoundingly low price when you spec and order the Guardian-Gold Series 1310S. (Still *another* miracle relay from your Guardian Angel[®])

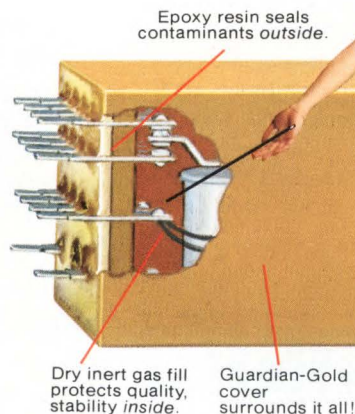
Send for specs and application data.



GUARDIAN[®]

GUARDIAN ELECTRIC MANUFACTURING CO. • 1550 W. Carroll Ave. • Chicago, IL 60607 • 312/243-1100

CIRCLE 638



Guardian-Gold cover surrounds it all!

SOFTWARE

Language builds faster expert systems

OPS83, a compiler-based programming language, serves as a universal tool for developing a wide range of knowledge-based expert systems. The greater efficiency of OPS83's rules and procedural sublanguage results in smaller programs, which execute at higher speeds and require fewer rule firings. The ability to call functions and subroutines from rules permits OPS83 programs to be more modular and easier to maintain. The language currently runs on VAX 11/750 and 11/780 computer systems, with others expected by the end of the year.

Production Systems Technologies Inc., 642 Gettysburg St., Pittsburgh, Pa. 15206; (412) 362-3117. \$10,000 for the first machine; \$6500 for each additional machine.

CIRCLE 366

DEC minis run IBM micro software

Cardware, a combination hardware and software package, allows Digital Equipment minicomputers to run PC-DOS, MS-DOS, and CP/M microcomputer software. The package consists of a Q-bus- or Unibus-compatible board with an 8088 processor, 192 to 768 kbytes of RAM, and an RS-232-C serial channel interface. It also includes file transfer, control, and utility programs, plus the applicable PC-DOS, MS-DOS, or CP/M-

86 license and manuals.

Cardware runs independent of the DEC system except for I/O requests. By typing a short command, users can switch between the DEC and microcomputer environ-

ments. Both DEC applications and microcomputer programs can run simultaneously at full speed.

Logicraft Inc., 3 Graham Drive, Nashua, N.H. 03060; (603) 888-4448. **CIRCLE 367**

WHEN IC DOESN'T MATCH PC, YOU NEED 4C

Incompatible IC pin outs used to be a real headache. Now, 4C ELECTRONICS' line of PROGRAMMED SOCKETS include configurations from 14 to 40 pins for instant pin out compatibility. Just install the 4C ELECTRONICS' PROGRAMMED SOCKET in place of your old IC, and plug in your newly sourced IC. You now have the best IC for the job on the job. The contacts are reliable, double sided gold. Closed entry simplifies IC insertion.

MAKE THE CONNECTION

To start getting IC's from more sources, facilitate new device evaluations, stretch inventories and make field retrofits quicker and easier, **call us with your order today.**

We'll have a configuration to suit your needs in days, not weeks — or write today for information.



4C ELECTRONICS, INC.

9330 Progress Parkway, P.O. Box 868, Mentor, OH 44060
(216) 354-6800, TWX: 810-427-2244

CIRCLE 639

SOFTWARE

Compiler and tools speed Pascal design

Users of DEC computers—from the biggest VAX to a personal computer like the Pro 350—can now share the

same design environment and optimizing compiler for their Pascal projects. Pascal-2 conforms to level 1 of the ISO 7185 standard, which specifies packed data structures and set types with up to 256

elements, as well as 1- to 32-bit integers and dynamic arrays. The compiler can also be instructed to accept a number of language extensions.

To generate code efficiently at 1600 to 2000 lines/min, Pascal-2 thoroughly optimizes it within one to two passes. The package's arsenal of tools includes two for automated formatting and an interactive debugger. Pascal-2 is currently available for the VMS operating system. Licensing fees start at \$4950.

Oregon Software Inc., 2340 SW Canyon Road, Portland, Ore. 97201; (503) 226-7760.

CIRCLE 368

MORE THAN 3000 INSTRUMENTS AND COMPUTERS HAVE IT...

IEEE 488

YOURS SHOULD TOO.

Ziatech can provide complete IEEE 488 compatibility for your device or computer. MULTIBUS*, STD Bus and IBM PC interface products are available from stock.

Ziatech engineers can also provide IEEE 488 hardware and software for your proprietary bus at a fraction of what it would cost you to design it yourself.

Ziatech also manufactures a complete line of high performance processors, memories and development systems for the STD Bus.

Call or write today to put Ziatech's 7 years of IEEE 488 experience to work for you.

ZIATECH
CORPORATION

3433 Roberto Court
San Luis Obispo, CA 93401 USA
(805) 541-0488 • ITT Telex #4992316

*MULTIBUS is a registered trademark for Intel Corp.



Program for HP-150 manages parts inventory

SCbase, a semiconductor inventory management system for the HP-150, uses specialized screen forms to speed data entry. It stores the rate of use, variation in rate, last three vendors, and prices for each part. SCbase can also search for a specific diode or transistor based on electrical specifications, as well as for a specific category. The program does not separate related parts (e.g., two chips that are identical except for clock speed), and it ignores insignificant leading and trailing letters when it is ordering the file. What's more, SCbase's command interpreter accepts synonyms, abbreviated commands, and misspellings.

Graceful Software, PO Box 4403-172, Austin, Texas 78765; (512) 478-8354.

CIRCLE 369

What's the fastest growing way to reach the international electronics market?



First in new technology coverage

Engineers and engineering managers worldwide turn to Electronic Design first for its *exclusive* electronics and computer design editorial covering new technologies, products, and applications. Special reports on European and Japanese technology provide designers with insights into the latest design trends — from components to computers. Our separate international section reports on the latest international news, meetings, and new product introductions.

First in market coverage

Electronic Design delivers 119,000 primary subscribers in 85 countries worldwide — the broadest, most efficient circulation coverage of any electronics publication. During the past four years Electronic Design's international circulation has grown 20% to now provide advertisers with the greatest market coverage in W. Europe of any U.S. electronics publication — more than 16,600 primary subscribers. Total circulation in the international section is now nearly 20,000.

First in advertising

Electronic Design is clearly the #1 publication in advertising pages.

1983 Advertising

Electronic Design	5,250 pages
Electronics	3,270 pages

In 1983, Electronic Design continued its dramatic growth in international advertising.

1980	227 pages
1981	297 pages
1982	328 pages
1983	355 pages

To join the growing list of advertisers using Electronic Design International, contact your local Electronic Design representative.

United Kingdom, Scandinavia

Constance McKinley
10 Mulholland Drive
Hasbrouck Heights, NJ 07604
Phone: (201) 393-6081
Telex: 710-990-5071
(HAYDENPUB HBHT)

Belgium, Holland, Switzerland, Germany

W.J.M. Sanders, S.I.P.A.S.
Oosterpark 6 — P.O. Box 25
1483 ZG DeRyp, Holland
Phone: 02997-1303 and 3660
Telex: 13039 SIPAS NL
Telegrams: SIPAS-Amsterdam

Italy

Luigi Rancati
20090 Segrate
Milano S. Felice Torre 5, Italy
Phone: 02-75-31-445
Telex: 311010 Orchid 1

France

Gerard Lasfargues
32 rue Desbordes Valmore
75116 Paris, France
Phone: 1-504-97-94

Japan

Haruki Hirayama, EMS, Inc.
Sagami Building, 4-2-21, Shinjuku
Shinjuku-ku, Tokyo 160, Japan
Phone: (03) 350-5666
Telex: 2322520 EMSINC J

Taiwan, Hong Kong, Singapore

Owen Wang
Ace Media Agency, Inc.
P.O. Box 26-578
Taipei, Taiwan, R.O.C.
Phone: (02) 7513636/4466
11876 HANDYAGE

ElectronicDesign

First place to address the international electronics market.

SOFTWARE

**Program creates
phone-call data base**

Call Tracker, a combination hardware-software package for PDP-11 and VAX computers, manages a telephone-call data base and performs automatic dialing. Written in Dibol, the package runs under RSTS/E or VMS and can handle as many users as there are terminals. Moreover, each user can create up to eight different data bases for fast access to such people as vendors, clients, or company managers. A review command steps through entries scheduled for follow-up calls, selected by level of importance, category, date, time

zone, or any combination thereof. Call Tracker displays the outcome of past conversations and dials any one of three numbers with a single keystroke.

Origin Inc., 9136 Gibson St., Los Angeles, Calif. 90034; (213) 202-0772. \$2500 (RSTS/E) and \$3000 (VMS), plus \$160/dialer.

CIRCLE 370

**Software tools
are based on Ada**

Consisting of the Byron program development language (PDL) and five tools, the Ada PDL Toolset supports the development of

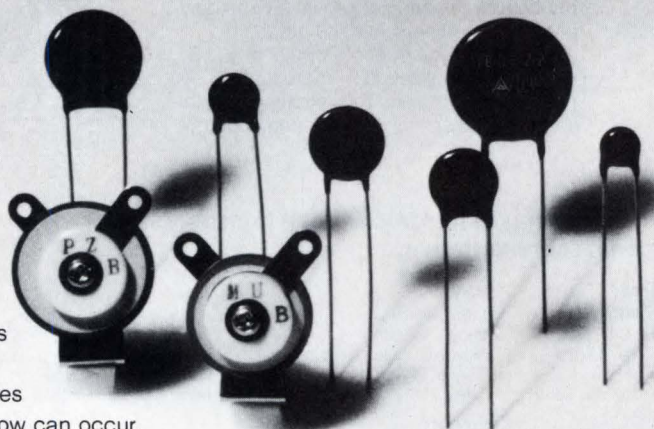
large software systems from conception to development. The product is available for VAX/VMS and IBM/MVS environments. The tools provide a uniform means of expression that can be used through all phases of a project and allow programs to be written for automated support. By making it possible to keep all information about a program unit in a single source file, Ada PDL Toolset helps ensure that documentation is consistent with the executable code.

Intermetrics Inc., 733 Concord Ave., Cambridge, Mass. 02138; (617) 661-1840. \$10,000 (VMS) and \$15,000 (MVS).

CIRCLE 371

POWER THERMISTOR

Inrush Suppressors



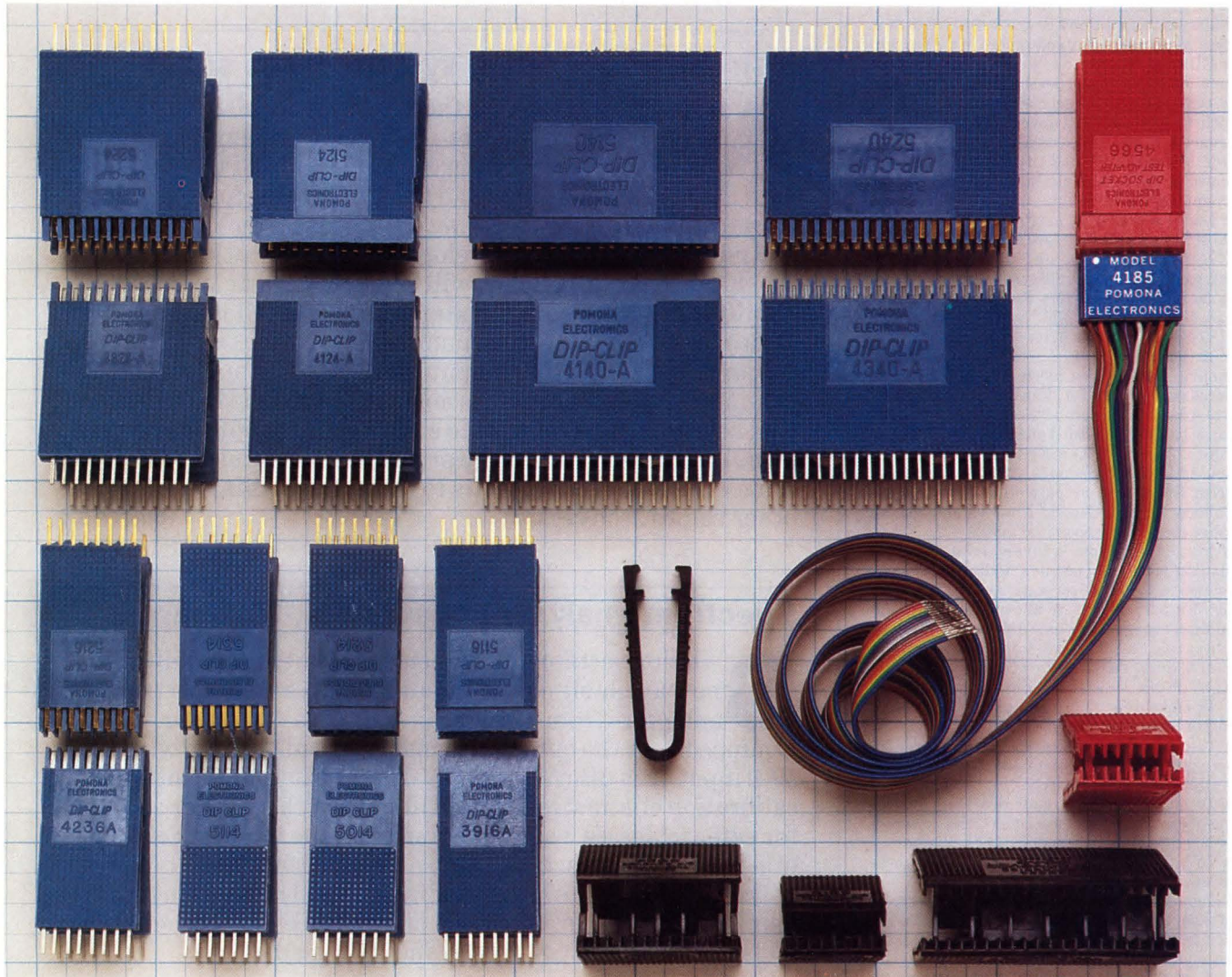
When power is first applied to an electronic circuit which uses a capacitor, heater or motor as the load, a inrush up to 100 times greater than the normal current flow can occur. Unsuppressed inrush in an electronic circuit can cause component breakdowns or malfunctions in the power supply, the main electronic circuit and the load.

SEMITEC**Ishizuka Electronics Corporation**

16-7, Higashikojiwa, 3-chome, Edogawa-ku, Tokyo 133, Japan TEL:03-658-5111
FAX:03-671-9835 TELEX:IZECCOJ J33324

THE POMONA PROMISE

Our constant goal is to provide the design engineer with the best DIP IC test clips made in this country. Or anywhere.



The best.

Yes, we know that's a big statement, the kind that puts your reputation on the line.

But that's okay with us because it's what we've been saying ever since we started in business back in 1951. So it's only natural that when we began producing test clips for dual in-line integrated circuit packages we would promise design engineers only one kind of performance. The best.

Well, we've been making the Dip Clip for quite a while now, and the professionals in the electronics industry who have used our prod-

ucts will tell you plainly and simply that we kept our promise.

At ITT Pomona Electronics, we know there is no such thing as standing pat. We also know that your needs change and your expectations become greater as the demands become more severe. To this end we will continue to create a better way. A better product.

That's a promise.

All of our products are described and illustrated in our General Catalog, and it's free. Just call (714) 623-3463 or 623-6751. TWX 910-581-3822. Write to us at ITT Pomona Electronics, a Divi-

sion of ITT Corporation, 1500 E. Ninth St., Pomona, CA 91766.

In Europe: ITT CANNON BELGUIM S.A./N.V. Rue Colonel Bourg Str. 105 Space A (B.3) 1140 Brussels, Belgium. Phone: 02-735-6094.

Our products are available through your favorite electronics parts distributor.

*Dip Clip is a trademark for a Pomona Electronics test clip.

ITT Pomona Electronics

ELECTRONIC DESIGN's function is:

- To aid progress in the electronics industry by promoting good design.
- To give the electronic design engineer concepts and ideas that make his job easier and more productive.
- To provide a central source of timely electronics information.
- To promote communication among members of the electronics community.

Want a subscription? ELECTRONIC DESIGN is circulated free of charge to those individuals in the United States and Western Europe who function in design and development engineering in companies that incorporate electronics in their end product and government or military agencies involved in electronics activities. For a free subscription, use the application form bound in the back of the magazine or write for an application form.

If you do not qualify, paid rates for a one year subscription (26 issues) are as follows: \$45. U.S., \$60. Canada, Mexico and Central America. International annual subscription rates listed below include air delivery: \$95. Europe; \$145. Japan, North Africa & Mid East; \$170. Australia; \$185. South America; \$210. Central/South Africa & Other Asia; \$245. New Zealand/ New Caledonia. Single copies (when available) may be purchased for \$5. U.S., Canada, Mexico & Central America; \$7. Europe; \$8. Japan, North Africa, Mid East, South America; \$10. Central/South Africa, Other Asia, Australia, New Zealand/New Caledonia. The GOLD BOOK (27th issue) may be purchased for \$50. U.S., Canada, Mexico, Central America and \$65. all other countries, via surface mail.

If you change your address, send us an old mailing label and your new address; there is a coupon in the Products section of the magazine for this purpose. Please allow 6 to 8 weeks for address change to become effective. You must requalify in order to continue receiving ELECTRONIC DESIGN free of charge.

ELECTRONIC DESIGN's accuracy policy:

- To make diligent efforts to ensure the accuracy of editorial matter.
- To publish prompt corrections whenever inaccuracies are brought to our attention. Corrections appear in "Letters."
- To encourage our readers as responsible members of our business community to report to us misleading or fraudulent advertising.
- To refuse any advertisement deemed to be misleading or fraudulent.

Individual article reprints and microfilm copies of complete annual volumes are available. Reprints cost \$6.00 each, prepaid (\$50 for each additional copy of the same article), no matter how long the article. Microfilmed volumes cost \$66.80 for 1982 (Vol. 30); \$75.70 for 1974-1981 (Vols. 22-29); \$50.20 for 1973 (Vol. 21); varied prices for 1952-1972 (Vols. 1-20). Prices are subject to change. For further details and to place orders, contact Customer Services Dept. University Microfilms, 300 N. Zeeb Rd., Ann Arbor, MI 48106. (313) 761-4700.

Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the base fee of \$1.00 per copy of the article plus 50¢ per page per copy. Payments accompanied by the identifying serial fee code below should be sent directly to the CCC, 21 Congress St., Salem, MA 01970. Copying done for other than personal or internal reference use without the express permission of Hayden Publishing Co./ELECTRONIC DESIGN is prohibited. Requests for special permission or bulk orders should be addressed to the editor. Serial fee Code: 0013-4872/1984 \$1.00 + .50.

Want to contact us? Address your correspondence to:

Editor
ELECTRONIC DESIGN
10 Mulholland Dr.
Hasbrouck Heights, NJ 07604

PRODUCT NEWS

Instrument operating system eases setup

A software package for the 9000 data acquisition and signal analysis system—a turnkey system that combines a waveform recorder with an IBM PC—supplies both the operating system and basic programs for analyzing waveforms and other incoming data, greatly facilitating setup and guiding users in the development of application software. The IOS 1.2 package, which will be introduced at Wescon by **Gould Inc.'s Recording Systems Division (Cleveland, Ohio)**, lets users perform a number of functions without writing any code. Using the computer to control as many as 112 incoming channels, it provides menus that use the PC's 10 function keys to set up from one to eight data acquisition and signal analysis systems. The program also lets users determine values, converting volts to revolutions/min, lb/in.², or other values as necessary.

CIRCLE 372

Spectrum analyzer accepts 50-, 75-Ω inputs

Switch-selectable 50-/75-Ω measurement capability is now available on the 496 and 496P portable spectrum analyzers from **Tektronix Inc. (Beaverton, Ore.)**. Equipped with the option, the analyzer reads in dBm with a 50-Ω input or in dBmV with a 75-Ω input. Automatic internal calibration eliminates the need to convert the units or account for external losses when changing from one impedance to another. The option covers a frequency range of 5 MHz to 1 GHz with 300-kHz resolution, providing optimal measurement capability for all cable and broadcast measurements. The option adds \$750 to the cost of the 496 and 496P instruments.

CIRCLE 373

Macintosh memory reaches 512 kbytes

The latest addition to the Macintosh product line—introduced by **Apple Computer Inc. (Cupertino, Calif.)** several months ahead of schedule due to the availability of 256k chips—comes equipped with 512 kbytes of internal memory. Dubbed the Macintosh 512k, the computer has a suggested retail price of \$3195. In addition, Apple also announced a price reduction and a 512-kbyte memory expansion option for the Macintosh 128k system. The Mac 128k now sells for \$2195; the 512-kbyte expansion kit is available for \$995. Both systems come with the MacWrite and MacPaint software programs.

CIRCLE 374

Instant logic programming CUPLed with universal high level language

With CUPL™, the first universal high level language for programmable logic, you can edit, simulate, logically reduce, document, and store your design.

Let us take you from idea to product in a CUPL of minutes.

You are free to define your logic with state machine syntax, Boolean equation, or function table. And, it's ready, right now, to operate in your IBM® PC (MS-DOS™), DIGITAL VAX®, (under VMS® and UNIX®), or CP/M® 80/86.

With the UP-803 PROM and logic programmer, you can design, program, and test over 100 PAL® and IFL logic devices (not to mention over 600 programmable memories).

Four test methods assure the in-circuit performance of the logic device: fuse verification, pseudo-random signature test, user defined

vector test, and a combined vector/random test.

We have prepared a 100 screen textbook on what programmable logic can do for you.

Call us for a demo and receive your free copy:

WAVETEK-DIGELEC
586 Weddell Drive, Suite #1
Sunnyvale, California 94089
Tel: (408) 745-0722
Tlx: 821-877 DIGELEC SUVL

Europe: WAVETEK-DIGELEC
Goldauerstrasse 35
CH-8006 Zurich
Switzerland
Tel: (01) 362 4000
Tlx: 815 750 DIGE CH

Following trademarks acknowledged:
CUPL - Assisted Technology, Inc., PAL - Monolithic Memories, Inc., IBM PC - International Business Machines, VAX & VMS - Digital Equipment Corporation, CP/M - Digital Research, UNIX - AT & T Technologies, Inc., MS-DOS - Microsoft Corporation.

Get your free copy of
PLUG, our textbook on
programmable logic



"SEE US AT WESCON, BOOTHS 1350 - 1357"

CIRCLE 642 FOR DEMONSTRATION
CIRCLE 643 FOR LITERATURE

Advertising Sales Staff

Paul C. Mazzacano, *National Sales Manager*
Sunnyvale, CA 94087 (408) 736-6667

Hasbrouck Heights, N.J. 07604

Thomas P. Barth, Robert W. Gascoigne,
Gail Goldstein, Constance McKinley,
Becky McAdams, Roberta Renard,
Stan Tessler, Carol Helton
Sales Assistants: Francine Guerra, Supv.;
Karen Schwartz, Bernadette Zajicek
10 Mulholland Dr., (201) 393-6000
TWX: 710-990-5071, (HAYDENPUB HBHT)

Philadelphia

Thomas P. Barth (201) 393-6072
Becky McAdams (201) 393-6074

Boston

M.E. "Casey" McKibben, Jr., Joseph Burke
600 Suffolk St., Lowell, MA 01853
(617) 459-0470, (617) 895-1719 (mobile)

Colorado

Jeff Hoopes (408) 736-6667

Chicago 60611

Thomas P. Kavooras, Craig L. Pitcher
Sales Assistant: Mary Nardulli
200 East Ontario, (312) 337-0588

Cleveland

Thomas P. Kavooras (312) 337-0588

Texas

Susan Abrahamson
9451 LBJ Freeway, Ste. 220
Dallas, TX 75243 (214) 234-0508

Arizona

Stanley Ehrenclou (213) 641-8544

Los Angeles 90045

Stanley I. Ehrenclou, Ian C. Hill
Sales Assistant: Betty Fargo
8939 South Sepulveda Blvd., Suite 260
(213) 641-6544

Orange County/San Diego

Charles Merritt
2082 Michelson Drive, Suite 212
Irvine, CA 92715 (714) 476-0315; (213) 641-6544

Pacific Northwest

Ian Hill (213) 641-6544

San Francisco

Bill Sleight, Rich Bastas, Jeff Hoopes, Pamela Rock
Sales Assistant: Jacqueline Gray
1307 South Mary, Suite 212
Sunnyvale, CA 94087, (408) 736-6667

Canada

Craig Pitcher (312) 337-0588

United Kingdom-Scandinavia/Israel

Constance McKinley
10 Mulholland Dr., Hasbrouck Heights, N.J. 07604
(201) 393-6000

Austria, Belgium, Holland

Switzerland, Germany
W.J.M. Sanders, S.I.P.A.S.
Oosterpark 6-P.O. Box 25
1483 ZGdeRYP, Holland
Phone: 02997-1303 and 3660
Telex: 13039 SIPAS NL
Telegrams: SIPAS-Amsterdam

France: Gerard Lasfargues

32 rue Desbordes Valmore
75116 Paris, France, Phone: 1-504-97-94

Italy: Luigi Rancati

20090 Segrate
Milano S. Felice Torre 5, Italy,
Phone: 02-75-31-445, Telex: 311010 Orchid 2

Japan: Haruki Hirayama, EMS, Inc.

Sagami Bldg., 4-2-21, Shinjuku,
Shinjuku-ku, Tokyo 160, Japan
Phone: (03) 350-5666, Telex: 2322520

Hong Kong-Taiwan

Owen Wang, Ace Media Agency, Inc.
P.O. Box 26-578
Taipei, Taiwan, R.O.C.
Phone: (02) 751-3636
Telex: 14142 ACEGROUP

Recruitment Advertising Manager:

Gail Goldstein (201) 393-6000
Susan Barnes

NEW PRODUCTS

PRODUCT NEWS

Products enhance 80286-based supermicros

Hardware and software enhancement packages from **Intel Corp. (Santa Clara, Calif.)** extend the functionality of its 80286-based 286/310 family of multi-user, multitasking supermicrocomputers. The 286/310's main memory has been expanded to 1 Mbyte and Winchester storage to 40 Mbytes. Other options include 1- and 2-Mbyte ECC RAM boards, an eight-channel serial I/O controller, a 45-Mbyte streaming tape drive, and an additional 40-Mbyte Winchester drive or a 320-kbyte floppy-disk drive. A new release of the Xenix operating system, which will be available in December, is compatible with IBM PC Xenix. Release 3.0 is a derivative of Unix System III and is available in a run-time system version or in an extended version, which includes complete software development tools, text processing, and other utilities.

CIRCLE 375

Add-on boards enhance HP desktops

Specializing in peripherals for Hewlett-Packard desktop computers, **Eventide Inc. (Little Ferry, N.J.)** has announced several board-level products, plus price reductions on existing products. For example, the company offers a 31% price slash for its recently introduced 1-Mbyte memory board (the WKBP-16) for the Series 200 machine. The WMAZ series of memory boards, which also received price cuts, adds a 2-Mbyte board for use with the HP 9845. Enhancing the HP 9825 is an interface board that gives the computer monochrome or color graphics capabilities. Finally, a general-purpose buffer that operates over the HP-IB is compatible with many Hewlett-Packard computers. The buffer provides 230 kbytes of usable RAM (about 70 pages of text) to eliminate bottlenecks at the printer.

CIRCLE 376

V-f display generates blinking characters

For applications requiring operator prompting, **Beckman Industrial Corp. (Fullerton, Calif.)** has introduced a 5-by-7-dot matrix vacuum fluorescent display subsystem that offers blinking characters as a standard feature, giving back to the host system much needed program software. Designated the Model VF-0140-02, it displays one line of 40 characters and incorporates a brightness control that adapts to most lighting environments. At full brightness, the readout is rated at approximately 200 fL. TTL parallel and serial data inputs are standard; an RS-232-C interface is available as an option. The display subsystem carries a one-year warranty and sells for \$164 in quantities of 100.

CIRCLE 377

PRODUCT NEWS

Controller boosts video rates to 128 MHz

A high-speed version of the uPD7220 graphics display controller, from **NEC Electronics Inc. (Mountain View, Calif.)**, is capable of generating video rates of up to 128 MHz and performing read-write-modify display memory cycles in just 500 ns. In addition to speed, the new device—designated the uPD7220A—offers greater performance than its predecessor. Its strengths include the ability to address up to 4 Mbits of video display memory; programmable vertical and horizontal timing; and an internal vector generator for drawing arbitrary vectors, arcs, circles, rectangles, and characters. Other features include direct-memory-access control, zooming, panning, scrolling, and split screen. The 7220A is offered in 6-, 7-, and 8-MHz versions, while the 7220 comes in 4-, 5-, and 5.5-MHz versions. The upgraded device is priced at \$130 in quantities of 100.

CIRCLE 378

Adapter programs 40-pin MegaPALs

Data I/O Corp. (Redmond, Wash.) has released an adapter for its programmable logic development system that programs and functionally tests Monolithic Memories' 40-pin MegaPAL device (the 32R16). The 303A-008 adapter is available in two configurations: one programs the leadless chip-carrier (LCC) version of the 32R16, while the other programs J-leaded chip carriers. Both adapter versions can also program dual-in-line packages. Because the 32R16 contains over 8000 fuses, the adapter provides storage for over 1000 structured test vectors to ensure reliable testing. It also checks for proper device insertion—a test that is especially critical for the square LCC and J-leaded devices since they can be inserted in four different ways. The 303A-008 is priced at \$1875 and has a lead time of 20 weeks.

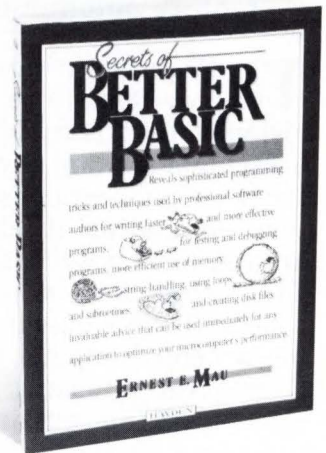
CIRCLE 379

Repackaged voltage converter saves space

The ICL7660 voltage converter is the first of a number of CMOS linear circuits, from **Intersil Inc. (Cupertino, Calif.)**, to be available in an 8-lead small-outline (SO) package. Of particular interest to users of low-power CMOS in portable battery-operated systems, the SO-packaged device is about one-third the size of conventional 8-pin mini DIPs. In addition, two SO packages can be mounted on the same pc board space, one from each side. Thus, users can reduce the amount of board space required by a factor of six. The lead time for the ICL7660CBA, which sells for \$2.36 in lots of 100, is 14 to 16 weeks for quantities of 5000 to 10,000.

CIRCLE 380

Discover the Secrets of Better BASIC



Secrets of Better BASIC Ernest E. Mau

Reveals the sophisticated programming techniques used by professional software authors to write more effective programs. Also discloses professional secrets for

- testing & debugging programs
- using memory efficiently
- executing loops & subroutines
- creating disk files

Helps you overcome the limitations of BASIC programming, improve program execution time, handle files more easily, and format your programs for easy reference.

#6254, \$14.95

Order By Phone • 1-800-631-0856
operator FE63 • In NJ 201-368-2202, ext. 19

Hayden

Dept. FE63 • Hayden Book Company, Inc.
10 Mulholland Dr., Hasbrouck Hts., N.J. 07604

Please send me **Secrets of Better BASIC**. If I am not completely satisfied, I may return the book undamaged within 10 days for a complete refund.

Please add \$2.00 to cover shipping and handling.

☐ Enclosed is my check or money order.
Please bill my ☐ Visa ☐ MasterCard

Name _____

Address _____

City _____

State/Zip _____

Visa/MasterCard # _____ Exp. _____

Signature _____ B228

Residents of NJ and CA must add sales tax.
Prices subject to change.

NEW LITERATURE

Publications on factory automation

The Manufacturing Technology Bookstore (a division of Tech Tran Corp.) is offering a catalog covering the latest publications on factory automation. It features approximately 100 titles on such subjects as industrial robots, flexible manufacturing systems, computer vision, CAD/CAM, automated material handling, automatic assembly, artificial intelligence, control systems, and speech technology. Publications include books, special reports, conference proceedings, and reference documents.

The Manufacturing Technology Bookstore, 134 N. Washington St., Naperville, Ill. 60540.

CIRCLE 381

Semiconductors for the military

Semiconductors for military and space applications are the subject of a brochure devoted to the activity of Thomson's Military and Spatial Division. The document, which includes quality-assurance information, contains data on high-speed digital circuits, 8/16-bit NMOS and CMOS microprocessors, linear bipolar circuits, gate arrays, and discrete components.

Thomson Semiconductors, Communication Department-Grenoble, 45 Ave. de l'Europe, 78140 Velizy, France.

CIRCLE 382

Power supply selector wheel



A power supply selection guide in the form of a handy reference wheel enables the user to quickly find the correct switching power supply for any application. The wheel, which covers 18 different supply types, is color-coded to correspond with Boschert's supply catalog. It indicates total power, single or multiple outputs, and whether the unit is UL/CSA specified (without an RFI filter) or specified to international standards (with an RFI filter.)

Boschert Inc., 384 Santa Trinita Ave., Sunnyvale, Calif. 94086.

CIRCLE 404

Low-impedance pressure transducers

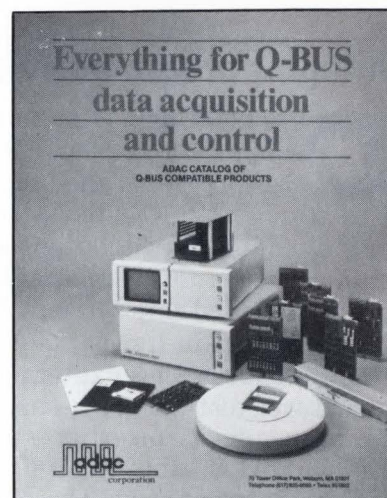
The 100 series of low impedance quartz pressure transducers with built-in amplifiers is specified in a four-page chart. The series, which comprises more than

45 devices, is well suited for test measurements or continuous monitoring applications in rugged field, factory, or underwater environments. Frequency-tailored models provide microsecond response times and nonresonant outputs.

PCB Piezotronics Inc., 3425 Walden Ave., Depew, N.Y. 14043.

CIRCLE 405

Data acquisition via the Q-bus



A 64-page illustrated catalog presents a line of Q-bus-compatible products used for data acquisition and control applications. Offerings include complete systems, bus enclosures, monitors, interface modules, wiring accessories, and I/O software. Technical articles on low-level multiplexing and signal conditioning for thermocouple inputs enhance the literature.

ADAC Corp., 70 Tower Office Park, Woburn, Mass. 01801.

CIRCLE 406

Standard cell application news

Scan is a newsletter that directly addresses the needs of designers currently using or considering standard cell technology in the design and manufacture of integrated circuits. Published every three weeks, the newsletter provides information about current trends in the industry and tutorial-type articles to aid in the application of standard cell design. One section offers a selection of pertinent reading material found in current trade publications.

International Microelectronic Products Inc., 2830 N. First St., San Jose, Calif. 95134.

CIRCLE 407

Insulation-displacement connectors

Photos, specifications, and dimensions are given in a 92-page catalog for the 2187 products that comprise an insulation-displacement connector line. Products include sockets, headers, card-edge connectors, D subminiatures, delta ribbon connectors, transition connectors, DIP cable plugs, and flat cable assemblies. The catalog also offers an illustrated selection guide and information on contact design, contact materials, selective plating, connector strain-relief options, and connector body designs.

Robinson-Nugent Inc., 800 E. Eighth St., New Albany, Ind. 47150.

CIRCLE 408

'Black Box' data-comm products



The mid-year edition of the Black Box catalog contains over 430 problem-solving products that enhance data communications and computer operation capabilities. Every product in the 128-page catalog is described in detail with photos, diagrams, text, and prices to make selection and ordering easier. The Black Box line ranges from basic installation hardware to sophisticated modems, protocol converters, interface test sets, data concentrators, and multiplexers.

Black Box Corp., PO Box 12800, Pittsburgh, Pa. 15241.

CIRCLE 409

Data communication products

Packed with a comprehensive selection of data communications products from

over 70 manufacturers, this 184-page catalog includes photos, schematic diagrams, and applications data. Products are grouped into 68 categories that include modems, multiplexers, channel-sharing units, protocol converters, local area networks, fiber-optic equipment, buffers, network management systems, test equipment of all types, cabinets, cables, tools, and more.

Glasgow Communications Inc., 207 Washington St., Northvale, N.J. 07647.

CIRCLE 410

Catalog presents ASTM publications

The 1985 American Society of Testing Materials publications catalog describes the 66 volumes of the *Annual Book of ASTM Standards* and several hundred ASTM technical publications, compilations, data series, and standard adjuncts. ASTM standards and its related technical publications are used worldwide to specify materials, assure quality, integrate production processes, and promote trade.

ASTM Marketing & Promotion Services, 1916 Race St., Philadelphia, Pa. 19103.

CIRCLE 411

Fiber-optic cable products

Revised to reflect current market requirements, a fiber-optic cable catalog in-

NEW LITERATURE

cludes step and graded index, single and multimode fibers in a number of standard designs. The features of each cable construction are presented to facilitate selection.

Times Fiber Communications Inc., 358 Hall Ave., PO Box 384, Wallingford, Conn. 06492.

CIRCLE 383

Resistors, magnetics, and semiconductors

Describing chip resistors for surface mounting, resistor networks, discrete leaded resistors, hard and soft ferrite magnetic materials, power semiconductors, and trimming potentiometers

is a 303-page catalog.

Allen-Bradley Electronics Group, Marketing Communications, 1201 S. Second St., Milwaukee, Wis. 53204.

CIRCLE 384

The ZetaLisp-Plus environment

Entitled *Productivity Plus*, this 12-page brochure describes the interactive environment provided by ZetaLisp-Plus and the Lambda Lisp machines. The first Lisp machine implementation to offer CommonLisp (the industry-standard Lisp dialect), enhanced ZetaLisp-Plus has a foundation of nearly

10,000 compiled functions and over 30,000 symbols.

Lisp Machine Inc., 6033 W. Century Blvd., Los Angeles, Calif. 90045.

CIRCLE 385

Acrylic adhesive for flexible circuits

Presented in a four-page pamphlet is an acrylic system for producing flexible circuitry and flat cable. Detailed performance specifications are given for Kapton copper laminates, adhesive-coated Kapton, and unsupported acrylic sheet adhesive.

Oak Materials Group Inc., 54 Church St., Hoosick Falls, N.Y. 12090.

CIRCLE 386

EQUIPTO Enclosures

We make your cabinet engineering easier

You know electronics. We know electronics cabinetry. So talk "engineer talk" by phone with your counterpart at Equipto... an engineer who knows your needs and how to fill them. He may suggest one of our more than 1200 stock models. Or he may design an enclosure just for you... even to meet EMI/RFI requirements if needed.

Modular or custom, you'll have a 3-view engineering drawing within days.

Ask about our unique engineering evaluation program too! Call Equipto now and talk to our consulting engineers. Our phone is (312) 897-4691. Or write for our free catalogs describing enclosures and computer furniture.



EQUIPTO
Electronics Corporation

419 Woodlawn Avenue
Aurora, IL 60506-9988
(312) 897-4691

CIRCLE 648

"SEE US AT WESCON BOOTH 2284"

CALLING ALL ENGINEERS

with custom relay requirements



Having trouble finding a source? Call Standex Electronics! Till now, we have been known for being aggressive in the high volume competitive reed relay market. With that market in hand—and quality control standards "second to none"—we're ready to source your custom reed relay needs with standard footprints. Engineers, send your specs to Standex. Let us assist you with your switching requirements. Contact Jim (617-834-9811) or Paul (617-883-7100) for personal assistance with your custom reed relay designs, or send your requirements to:

**Standex
Electronics**

4538 Camberwell Road, Cincinnati, Ohio 45209 513-871-3777
Morley Road, Tonbridge, Kent, England 732-358398

Standex company

SEE US AT WESCON BOOTH 1378
CIRCLE 649

NEW LITERATURE

Components for
printers

Eight products that are used in the design of printers are described in a three-page bulletin. These include Mini/Bus printed circuit board bus bars, flexible circuits, and materials for RFI/EMI shielding. A low-profile interconnection system for flexible circuits is also presented, as well as Mektron micromotion keyboards, polymer products, RX engineering thermosets, and Endur-C microcellular urethane feed components. Sketches show how each product is used within the printer.

Rogers Corp., 1 Technology Drive, Rogers, Conn. 06263.

CIRCLE 387

NTC and PTC
thermistors

A short-form catalog (SF-784) specifies a line of NTC and PTC thermistors and probe assemblies, including applications data for each type. NTC (negative temperature coefficient) devices are presented in chart-form and cover glass-bead, glass-probe, glass-encapsulated, rod-type, and disk-type (with crossed leads) thermistors. PTC (positive temperature coefficient) devices include 24 disk types, plus groups of PTC resettable fuses, heaters, and surface-mounted overtemperature protectors.

Keystone Carbon Co., Thermistor Division, St. Marys, Pa. 15857.

CIRCLE 388

Interconnection
components

A 352-page catalog (No. 840) includes photos, three-dimensional drawings, technical data, and ordering information for 25,000 electrical and electronic interconnection components and associated application equipment. The literature is divided into sections for pin and socket connectors, plastic D subminiatures, solderless terminals, pc board interconnection systems, 0.050-in. centerline planar cable connectors, IDCs, edge connectors, switches, sockets, and more.

Molex Inc., 2222 Wellington Court, Lisle, Ill. 60532.

CIRCLE 389

Satellite
communications

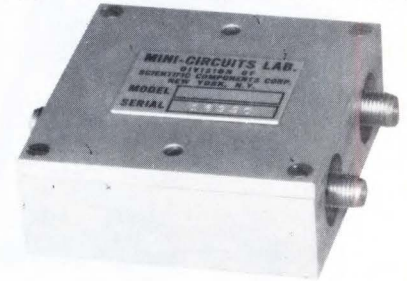
Satellite communications is the subject of an 18-page brochure, which provides an overview of various products and the technology used to design them. The literature covers time-division multiple-access (TDMA) systems, single-channel-per-carrier (SCPC) equipment, products incorporating digital speech interpolation, audio and video codecs, and the Macomnet video-teleconferencing system. Also included in the brochure is a general description of turn-key earth station projects and support services.

M/A-Com DCC, Inc., 11717 Exploration Lane, Germantown, Md. 20874.

CIRCLE 390

double
balanced
mixers

standard level (+ 7 dBm LO)



1.5 to 4.2 GHz
~~\$74⁹⁵~~ now \$39⁹⁵ (1-9)

AVAILABLE IN STOCK FOR
IMMEDIATE DELIVERY

- rugged 2 in. sq. milled aluminum case
- SMA connectors
- low conversion loss, 7.5 dB
- IF response, DC to 500 MHz
- isolation, 20 dB
- microstrip construction

ZAM-42 SPECIFICATIONS

FREQUENCY RANGE, (GHz)

LO, RF 1.5-4.2

IF DC-0.5

CONVERSION LOSS, dB

Total range TYP. 7.0 MAX. 8.5

ISOLATION, dB TYP. MIN.

1.5-2.0 GHz LO-RF 25 20

LO-IF 18 10

2.0-3.7 GHz LO-RF 25 17

LO-IF 18 10

3.7-4.2 GHz LO-RF 25 20

LO-IF 18 10

SIGNAL 1 dB Compression level +1 dBm

For complete specifications and performance curves refer to the 1980-1981 Microwaves Product Data Directory, the Goldbook or EEM.

finding new ways...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
P.O. Box 166, B'klyn, N.Y. 11235 (718) 934-4500

C84-3 REV. ORIG.

CIRCLE 644

NEW LITERATURE

Analog and digital panel meters

A 28-page brochure (No. 5400-P) presents an entire stock line of over 1500 analog and digital panel meters, meter relays, and controllers. Also included in the document are panel-mounted chart recorders. The instruments are offered in sizes ranging from 1½ to 7 in. and in a variety of ranges.

Simpson Electric Co., 853 Dundee Ave., Elgin, Ill. 60120.

CIRCLE 391

Expert system for process control

A Lisp-based real-time expert system for the process control industry is the subject of a four-page pamphlet. The system, called PICON (Process Intelligent Control), operates in a Lambda/Plus Lisp machine having both a Lisp and a 68010/Unix-based processor, which is connected to an existing distributed process control system. In addition to monitoring up to 20,000 measurements and alarms,

PICON assists the operator in dealing with process interruptions and faults.

Lisp Machine Inc., 6033 W. Century Blvd., Los Angeles, Calif. 90045.

CIRCLE 392

Liquid-crystal display panels and modules

A guide to liquid-crystal display panels and modules includes full-size color illustrations of each type. The booklet covers 24 styles of displays, ranging from single- and double-line alphanumeric types to full dot-matrix graphics panels. Electrical and mechanical specifications are given, as well as the part numbers for corresponding controller ICs.

Hitachi Electronic Components Ltd., Hitec House, 221/225 Station Road, Harrow, Middx. HA1 2XL, England.

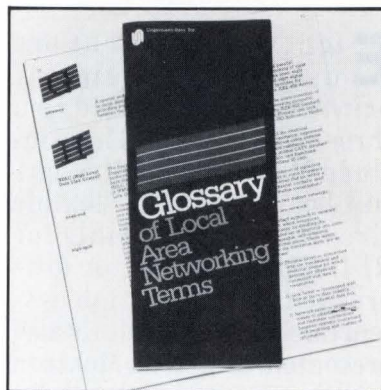
CIRCLE 393

High-current filter chokes

Data sheets present three series of high-current filter chokes for EMI/RFI filtering and for energy storage inductance in switching power supplies. Products covered include toroids in 25 ratings from 7 μ H/11 A through 7500 μ H/1.53 A; chokes in 30 ratings from 5 μ H/15 A through 10,000 μ H/1.5 A; and chokes in 25 ratings from 5 μ H/10 A through 250 μ H/4A.

Bell Industries, J.W. Miller Division, 19070 Reyes Ave., Rancho Dominguez, Calif. 90224.

CIRCLE 394

Glossary of LAN terms

More than 100 commonly used terms are presented in the 24-page *Glossary of Local Area Networking Terms*. The two-color document explains the differences between LAN media, access methods, and topologies. In addition, it defines the major standards, protocols, and communications terms such as gateway, datagram, virtual circuit, and packet switching.

Ungermann-Bass Inc., 2560 Mission College Blvd., Santa Clara, Calif. 95050.

CIRCLE 395

Automatic wafer prober

The features and options of an ac high-frequency automatic wafer prober are given in a four-page flyer. The Model PR-54 is compatible with most ac test heads and offers automatic thickness compensation with programmable overtravel, motorized theta control, and an IEEE-488 bus interface.

Teledyne TAC, 10 Forbes Road, Woburn, Mass. 01801.

CIRCLE 396

NEW LITERATURE

**DEC add-ons
and upgrades**

Complete with detailed descriptions of each entry, a 132-page catalog covers a variety of offerings for Digital Equipment's VAX, PDP-11, and personal computers. Product categories include CPU upgrades, memory products, disk drives, tape drives, software, video terminals, printers, graphics hardware and software, communications products, and add-ons for personal computers. A section discusses the benefits of building a VAX-cluster system to meet increasing performance demands.

Digital Equipment Corp., Add-on and Upgrade Group, Continental Blvd., MK01/W83, Merrimack, N.H. 03054.

CIRCLE 397

**Liquid-crystal
displays**

Optel liquid-crystal displays—including digital, alphanumeric, instrument, dot-matrix, and bar-graph types—are presented in a pamphlet that provides a complete table of pin-out designations for each model, plus front and cross-sectional views with both English and metric dimensions. A postage-paid mailer for specifying an LCD is provided, along with a model specification and ordering matrix, a table of fluid specifications, and details of mounting methods.

Refac Electronics Corp., PO Box 809, Winsted, Conn. 06098.

CIRCLE 398

**Flat-cable
connector series**

Containing full electrical and dimensional specifications, a 42-page catalog presents the 700 series of insulation-displacement flat-cable connectors. The 700 series offers a wide variety of connectors, including transition, card-edge, D-subminiature, and Delta ribbon types, as well as headers and sockets.

Fujitsu America Inc., Components Division, 918 Sherwood Drive, Lake Bluff, Ill. 60044.

CIRCLE 399

**Electronic products
from A to Z**

Tens of thousands of items from over 200 major manufacturers are presented in a 912-page distributor catalog (No. 107). Product descriptions, which include electrical and physical specifications, are given for semiconductors, resistors, capacitors, potentiometers, controls, switches, relays, fuses, transformers, connectors, sockets, wire, cable, lamps, LEDs, and other electronic products.

Newark Electronics, 500 N. Pulaski, Chicago, Ill. 60624.

CIRCLE 400

**Linear dc
servo amplifiers**

Detailing the operation of the EM19 and EM21 linear dc servo amplifiers is a 16-page catalog that defines applications, describes the

available enclosures, explains options, and lists complete specifications and dimensions. Diagrams and schematics cover modes of operation and interconnections.

Inland Motor, Specialty Products Division, 4020 E. Inland Road, Sierra Vista, Ariz. 85635.

CIRCLE 401

**Voltage transient
protectors**

The PB series of pulse over-voltage gaps is the subject of a four-page data sheet, which gives device features, characteristics, and mechanical data. The ceramic-metal gaps can conduct peak fault currents up to 1500 A, with fault current rise times on the order of 1 to 5 ns. In addition, their small size is suitable for pc board use and other space-restrictive applications.

EG&G Electronic Components, 35 Congress St., Salem, Mass. 01970.

CIRCLE 402

**Precision tools
and test equipment**

Illustrated in full color, a 160-page catalog contains more than 3000 tools of interest to engineers, technicians, and computer/telecommunications service persons. Major categories cover test instruments, power tools, soldering equipment, computer accessories, circuit board equipment, and over 40 pages of service kits and tool cases.

Jensen Tools Inc., 7815 S. 46th St., Phoenix, Ariz. 85040.

CIRCLE 403

Recruitment Advertising

ElectronicDesign

YOU CAN REACH ENGINEERS WITH TITLES LIKE THESE:

- Test Engineer • Systems Engineer • Digital Engineer • Quality Assurance Engineer • Software Engineer • Analog Engineer • Director of Engineering • Data Communications Engineer • Hardware Engineer • Project Engineer • Software Development Engineer • Microwave Engineer • Reliability Engineer • R & D Engineer • Operations Manager

Circulation 111,580
Total Readership 350,000

RECRUITMENT CLOSING DATES

Electronic Design is mailed every two weeks. Because of its timeliness, personnel recruitment advertising closes only two weeks before each issue's mailing date.

Issue Date	Closing Date	Mailing Date
Nov. 15	Oct. 26	Nov. 9
Nov. 29	Nov. 9	Nov. 23
Dec. 13	Nov. 23	Dec. 7
Dec. 27	Dec. 7	Dec. 21
Jan. 10	Dec. 21	Jan. 4
Jan. 24	Jan. 4	Jan. 18

ElectronicDesign RECRUITMENT ADVERTISING RATES

15% commission to recognized agencies supplying offset film negatives. Net 30 days. Four column makeup.

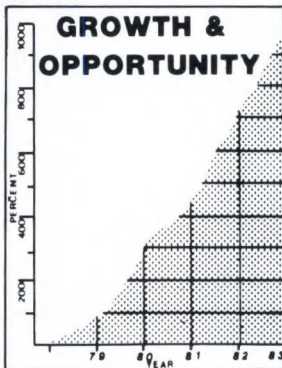
SPACE	DIMENSIONS		COST
	Wide	Deep	
One column inch	1-3/4" x 1"		\$91
1/8 page	1-3/4" x 5"		\$451
1/4 page	1-3/4" x 10" Vert.		\$901
	3-1/2" x 5" Hor.		
1/2 page	3-1/2" x 10" Vert.		\$1,802
	7" x 5" Hor.		
3/4 page	5-3/4" x 10"		\$2,703
1 page	7" x 10"		\$3,604
Rates	1X	4X	7X
Per Column Inch	\$91	\$89	\$83
	\$77	\$74	\$71
	\$70	\$68	

COLOR RATES	
Second color, per page or fraction	\$430
Additional insertions, same form	310
3 & 4 color, per page or fraction	780
Additional insertions, same form	460
Matched color, per page or fraction	\$735
Additional insertions, same form	430
Sheen inks, per page or fraction	835
Additional insertions, same form	430

Camera-ready film (right reading negatives, emulsion side down) or camera-ready mechanicals must be received by deadline. Or, if you wish us to set your ad (typesetting is free) simply pick up the phone and call our **RECRUITMENT HOT LINE** — (201) 393-6000/6076. Ask for:

Gail Goldstein
RECRUITMENT ADVERTISING MANAGER
ELECTRONIC DESIGN

10 Mulholland Drive, Hasbrouck Heights, New Jersey 07604



ELECTRONIC ENGINEERS

Red Lion Controls

One of the Country's 500 fastest growing companies

RED LION CONTROLS, an internationally known manufacturer of Micro Electronic indicators and controls has been recognized as one of the INC. 500.

Continued expansion is creating new opportunities for senior level PROJECT and DESIGN ENGINEERS who are self-starting innovators. Join our team of Engineers and take total project responsibility to match your growth with Red Lion Controls.

Strong background in the application of analog, digital and microprocessor design in developing products to solve instrumentation and measurement problems required.

We offer an excellent compensation and employee benefit package in a challenging, high-visibility environment.

Send resume and salary history to:

Personnel Administrator

RED LION CONTROLS

Willow Springs Circle, RD 5 York, PA 17402

equal opportunity employer



Creative Imagination

INTO MEMORY INNOVATION

VISIC — the pacesetter start-up developing revolutionary CMOS RAMS and causing a stir in the industry. We're shaping imaginative solutions to the traditional dilemmas of memory design with insightful innovations, renewing the focus and commitment to advances in the field. We're looking for more technological pioneers to lead the way in

MOS memory advances — achievers who want to join us in spearheading some of the most significant product developments in the industry. Be part of our dynamic team transforming technological visions into practical realities, meeting aggressive goals for entry into a marketplace awaiting the introduction of our product line.

DESIGN PROJECT ENGINEERS

Significant opportunities to design high performance memory products beginning at conceptualization and working through circuit synthesis, topological design & circuit analysis techniques and on through analysis & debug of finished product to production. BSEE with 3-5 years in NMOS or CMOS RAM design experience. DRAM background would be ideal.

PRODUCT ENGINEERING MANAGER

You'll handle the backend memory product responsibilities in a dynamic start-up environment. From a shirtsleeves beginning, your organization will grow to stay apace of VISIC's growing product portfolio. BS degree and a minimum of 5 years in memory product engineering (preferably DRAM experience). Teradyne and Accutest equipment experience preferred.

CAD DEVELOPMENT ENGINEER

Your primary focus will be on IC mask verification, extraction and simulation tools requiring minimum 3 years IC CAD development experience plus 2 years IC CAD use background. BS/MSEE or CS, including UNIX*, "C", PASCAL and FORTRAN programming skills. (*UNIX is a registered trademark of AT&T Bell Laboratories.)

PROCESS ENGINEER

Be involved in advanced lithography projects and sustain existing processes with potential involvement in other module process development. BSEE or related scientific discipline plus 1-2 years experience in lithography masking area.

PRODUCT ASSURANCE MANAGER

Assume major responsibilities for formal qualification of CMOS memory products and optimize the reliability of new & existing products. BSEE, Physics or Material Sciences required and a minimum of 5 years experience.

LAYOUT DESIGNERS

Rare opportunities for talented key contributors to be responsible for chip architecture, cell optimization and minimization of critical node capacitance. 3-5 years of RAM layout experience with knowledge of NMOS and/or CMOS a must. AA would be ideal.

Salaries and benefits are excellent and EQUITY PARTICIPATION will be just one of the additional rewards at VISIC, along with technical growth and industry advancement unparalleled anywhere. For immediate consideration, please fill out Mini-Application below or forward resume to Professional Staffing Department, VISIC, Inc., 1120 Ringwood Court, San Jose, California 95131. (408) 945-9991. An equal opportunity employer.

Mini-Application

Name	Telephone	
Address		
City	State	Zip
Position of Interest		
Current Position		
Company	Dates: From/To	
Education/School	Dates	Degree



**EXCEL-ERATION
EXCEL-ERATION
EXCEL-ERATION
EXCEL-ERATION
EXCEL-ERATION
EXCEL-ERATION
EXCEL-ERATION**

Your opportunity for rapid advancement

Excel at Bourns as we accelerate our already powerful international presence.

We're moving from dominance in electronic components, transducer instruments, optics and transformers toward prominence also in telecommunication products, test and measurement equipment, industrial control systems, aerospace systems of many kinds and IC production.

We're expanding and continually upgrading our facilities, resources and operations. Adding new products and divisions. Invigorating our whole extensive organization with talented technical people and high energy management. And using our steady long term success to push into a second generation of exciting growth.

You can grow too, in professional advancement and job satisfaction. All when you come to Bourns where the standards and rewards are high. We are particularly interested in professionals in the following areas: Engineering, Manufacturing, Research & Development, Sales, Marketing and Finance.

To inquire about employment at one of our many national and international locations, contact our Corporate Staffing Manager at (714) 781-5652 or send your resume to Bourns, Inc., Dept. AC13, 1200 Columbia Avenue, Riverside, CA 92507.



An Equal Opportunity Employer M/F/H



We're looking for people who can see beyond the obvious.

If Isaac Newton hadn't been astute enough to look beyond a simple act of nature to one of nature's fundamental principles, he would have missed the opportunity to discover the law of gravity.

If LINKABIT engineers weren't thinking about what could be, instead of what is, we wouldn't be at the forefront of the telecommunications industry.

Thanks to a cadre of conceptual achievers, however, LINKABIT has continued to set the standard in diverse and complex projects such as MILSTAR terminals, video scrambling equipment, domestic satellite systems, modems, codecs, advanced processors and fault-tolerant systems.

Now, we're looking for more of the same kinds of thinkers to join our ranks in the following areas:

- Satellite Data Communications
- Satellite Network Technologies
- Information and Network Security
- Speech Coding and Compression
- Local Digital Switching Systems
- Modulation and Coding Techniques
- Synchronization Techniques
- Advanced Digital Signal Processing
- RF & Analog Design
- Power Supply & EMI/EMF Analysis
- Systems Software

The creative, free-thinking atmosphere at LINKABIT promotes excellence and is a reflection of our physical environment. San Diego, America's Finest City in location, climate, cultural and recreational facilities, offers you and your family an unsurpassed lifestyle. This invigorating setting, combined with the challenge, satisfaction, and reward of a career at LINKABIT, provides an unbeatable opportunity to fulfill your goals. Opportunities are also available in the Washington, D.C. area and Boston.

If you see your opportunity here, send your resume to: Dennis Vincent, M/A-COM LINKABIT, 3033 Science Park Road, San Diego, CA 92121.

You'll discover a world of obvious possibilities.



M/A-COM LINKABIT, INC.

Equal Opportunity/
Affirmative Action Employer

ADVANCED TECHNOLOGY ENGINEERS

Active/Passive Microwave-Millimeter Wave Integrated Circuit Design

BSEE or equivalent, MSEE desirable. Related experience in **RECEIVERS—ANALOG—DIGITAL**.

AUTOMATIC TEST EQUIPMENT ENGINEERS

BSEE or equivalent, and related software/hardware experience required; advanced degree and avionics/military ATE background desirable.

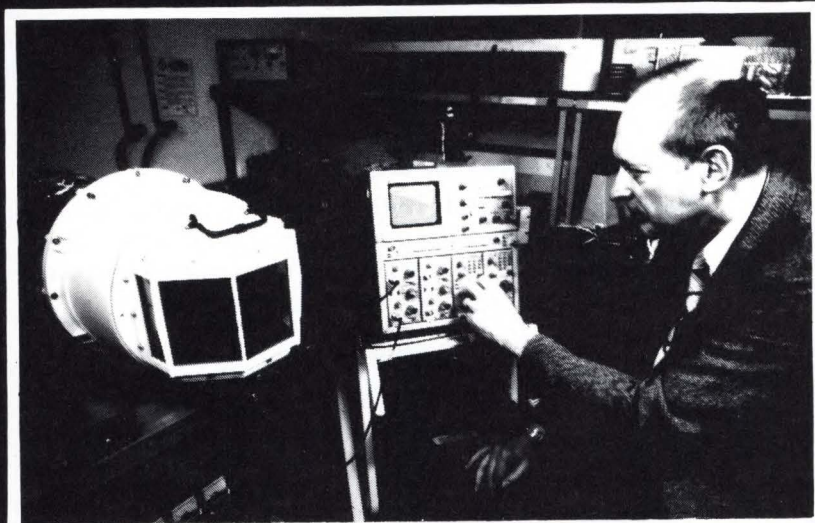
MICROWAVE PROCESS ENGINEERS

BSEE or equivalent, 2-5 years experience in microwave assembly operations.

SOFTWARE ENGINEERS

BSCS/BSEE or equivalent, and experience in one of the following: **REAL-TIME PROCESS CONTROL** (Assembly/Fortran)-**ATE SYSTEMS SOFTWARE** (Fortran 77/PASCAL).

At our high technology facility in Rolling Meadows, Illinois, just northwest of Chicago, Northrop Engineers collaborate on special projects involving the design and development of sophisticated ECM systems. If you have experience in any of the above areas, join the finest minds in engineering at Northrop Defense Systems Division.



THE ENGINEERING FACTOR

ANTENNA DESIGN ENGINEERS

BSEE or Physics or equivalent, MS desirable. Requires knowledge of phased arrays, monopulse, D.F. system and millimeter wave techniques.

POWER SUPPLY DESIGN ENGINEERS

BSEE or equivalent, MS desirable. Experience in switchmode/linear power system design at high or low voltages.

ELECTRONIC DEVELOPMENT ENGINEERS

Advanced Airborne Electronics Systems

BSEE or equivalent, and related project/hardware design engineering experience.

SYSTEMS ENGINEERS

Threat Analysis/EW Techniques Development

BSEE or equivalent, and related experience.

Send resume with salary requirements or **MAIL MINI PROFILE** to: Supervisor, Staffing.

Or for immediate consideration, call our 24-hour toll free number 1-800-821-7700 Ext 120

NORTHROP

Defense Systems Division
Electronics Systems Group

**600 Hicks Road,
Rolling Meadows, IL 60008**

We are an equal opportunity employer and encourage minorities, females, veterans and the handicapped to apply US Citizenship Required

MINI PROFILE

MAIL TO: SUPVR. STAFFING NORTHROP CORP.,
600 Hicks Rd., Rolling Meadows IL 60008

NAME

HOME ADDRESS

CITY, STATE, ZIP

HOME PHONE

WORK PHONE

CURRENT POSITION

YRS. OF EXPERIENCE

COMPANY

CAREER INTEREST



Sperry

In Albuquerque



Try your hand at some revolutionary technology with Sperry's Flight Systems group, leading supplier of sophisticated electronics to world aviation. We're looking for **engineers** to work with:

CRT Display Development

We're clearly the leader in the development and production of electronic display systems for aircraft cockpits such as the F-15, F-16, and F-111 fighters and the B1-B bomber. These displays provide crucial information to flight crews quickly and efficiently, in a wide variety of formats and colors. Join us in the following areas:

Electronic Design

BSEE degree and two or more years' experience in analog or digital design required. Some experience with monochrome and/or color CRT systems including display processor or a closely related field is also preferred. Customer interface and proposal experience is also desired.

- High speed digital processing
- Analog-to-digital converters
- Raster/stroke CRT circuitry design

We also have openings in the following areas:

- Helicopter avionics
- Flight controls
- Power supply design
- Electronic packaging engineering
- Reliability/components
- ATE Hardware Design

Reap the Rewards

With Sperry, you'll enjoy a competitive salary, generous benefits and a professional, state-of-the-art working environment. Find out more — send your resume and salary history, in confidence, to Brandon Harwood, Sperry, P.O. Box 9200, Albuquerque, NM 87119.



Equal Employment Opportunity/Affirmative Action Employer.
U.S. citizenship required.

ENGINEERING

Top Producer in the largest personnel network system currently has openings for ALL Engineering disciplines. We offer over 200 offices throughout the U.S. and Canada. All fees, interview and relocation expenses are borne by our client companies. Please call or submit your resume to:

RIKER PERSONNEL
8790 Purdue Road, Suite E
Indianapolis, IN 46268
(317) 875-9911

ENGINEERS

Nationwide professional search/recruiting
Serving high technology industries since 1958

- Aerospace • Defense • Electronics
- Analog/Digital Design • ATE
- Communications • CAD/CAM • Robotics
- Software/Hardware • LSI/VLSI
- Optics • E/W • Image Processing
- Microwave Systems • Sonar
- Microprocessors (Hardw/Sftwr)

Charles A. Binswanger
ASSOCIATES INC.

EXECUTIVE SEARCH SPECIALISTS
P.O. Box 5325 • Baltimore, Md. 21209 • 301/433-6610

YOU REACH ENGINEERS WITH TITLES LIKE THESE:

- Chief Engineer
- Development Engineer
- Design Engineer
- Project Engineer
- Electronic Engineer
- Engineer-Supervisor
- Section Leader
- Staff Engineer
- Systems Engineer
- Test Engineer
- Standards Engineer
- Master Engineer

ElectronicDesign

PRINCIPAL ENGINEERS



...with Digital's Western Engineering Group in the Pacific Northwest

Digital knows discovery is more likely to happen in small groups.

We believe that if you're trying to create the perfect environment for invention you have to think small, intimate, personal. And you have to think open and free.

If you're looking for a fast breakthrough, you have to put a few thinkers together and give them the freedom from structure that allows them to get the job done.

Because the human mind likes nothing better than to take on the impossible — in the company of a friend.

Digital's Western Engineering Group demonstrates our belief that a big mind in a small group finds the fast answer.

A small number of design specialists has left Digital's Engineering and Design Group in the East and established an independent operation in Seattle.

They thought the sea, the mountains, the wide open spaces and a wide open intellectual environment would be more conducive to discovery. This new group has openings for additional Principal Engineers who would step in as senior members of the design team.

Principal Engineer Packaging & Power Systems

You can expect to be involved in overall design and development activities relating to power and packaging of new computer systems. Expertise in Power System Design, Mechanical Design, Cooling, Cabling and PCB design is essential. Broad responsibilities include investigation of new technology and coordination of computer products and/or systems. BS/CS or EE or equivalent, with 5-7 years related experience.

Principal Engineers Logic Design

You will be charged with overall design and development for some integral parts to a next generation computer system requiring some in-depth experience with pipeline machine architecture as it applies to design and test. We're seeking proven implementors with working knowledge of state-of-the-art CAD tools (custom VLSI, gate arrays, standard cell architecture), Component Technologies and PCB Technology. A working knowledge of the VAX Architecture would be a real asset. BS/CS or EE or equivalent, with 5-7 years related experience.

Principal Engineer Electrical Design Systems

Assume key responsibility for the signal integrity of a new computer system, including electrical design verification. You will apply your strong EE background which focuses on EMI/RFI Protection, Transmission Theory and Circuit Simulation/Analysis techniques. Your proven strengths in theory and analysis in the field of electricity and BS/EE or CS or equivalent, with 5-7 years related experience would be ideal.

If you're interested in moving your considerable talents to Breakthrough Country and you yearn for a setting that provides independent technical action to develop ideas through to working realities, please expedite your resume to Dave Cutler, c/o Anne McCreary, Dept. 1014 3808, Digital Equipment Corporation, 11040 Main Street, Bellevue, Washington 98004. Attractive relocation assistance available.

People and Technology...
PERFECT INTERACTION

digital™

no limit

Daisy Systems is the NO LIMIT company with accelerated goals for the future of CAE.

That means we're not resting on past accomplishments. We're moving ahead. Investing in R&D. Expanding our leading edge family of workstations. And producing the kind of hardware and software systems that are integrated to do it all. That's productivity! And it takes creativity. So we've cleared the way for you to be an Engineer, in every creative sense of the word. Without the limits.

CAD Engineers

- Automatic placement & routing algorithms • Data base design
- Hierarchical simulation • Graphics & human interface

Systems Engineers

- Operating Systems • Diagnostics • Data communication/LAN
- I/O driver writers • UNIX* development

Support Specialists

- Pre/post sales applications engineers • Product engineers
- Customer training specialists

Give us your individual touch. Achieve. Be appreciated and rewarded — in a climate where possibilities are real — professionally and personally.

Go beyond your present creative limits. Join Daisy. We offer an attractive compensation and benefits package including stock option package, company-paid medical and dental insurance and relocation assistance. For immediate consideration, send your resume to Tom Schaeffer, Personnel, Daisy Systems Corporation, 139 Kifer Court, Sunnyvale, CA 94086. (408) 773-9111. An equal opportunity employer.



*UNIX is a trademark of AT&T Bell Laboratories

Sunbelt Opportunities
in Electronics
1-800-428-4406
Toll free

★ **South & Southwest** ★
Engineering / Management
send resume or call
Bob Hogue; Sr. Mbr. IEEE
SouthWest Technical
P.O. Box 33070 San Antonio, Texas 78265
(512) 650-0988
★ ★ Clients Pay All Fees ★ ★

Electronic Design

BRINGS YOU
THE HIGHEST
NUMBER
OF QUALIFIED
EOEM
ENGINEERS AND
ENGINEERING
MANAGERS
ANYWHERE
... AT THE
LOWEST COST
ANYWHERE!

**PUBLISHED
EVERY TWO WEEKS**

Because there is an issue of Electronic Design published every two weeks — 26 times a year — your help-wanted message gets into the marketplace quickly, yet gains the impact that only a technical journal can provide.

MOTOROLA'S GOVERNMENT ELECTRONICS GROUP

Motorola's Government Electronics Group is a leader in the research, development and production of electronic hardware for our country's defense, security and space programs. Our success is founded on the strengths of people like Ray Waddoups. People with the minds to imagine and the skills to do.

If you are such an individual and have a background in one of the following areas, we'd like to talk to you.

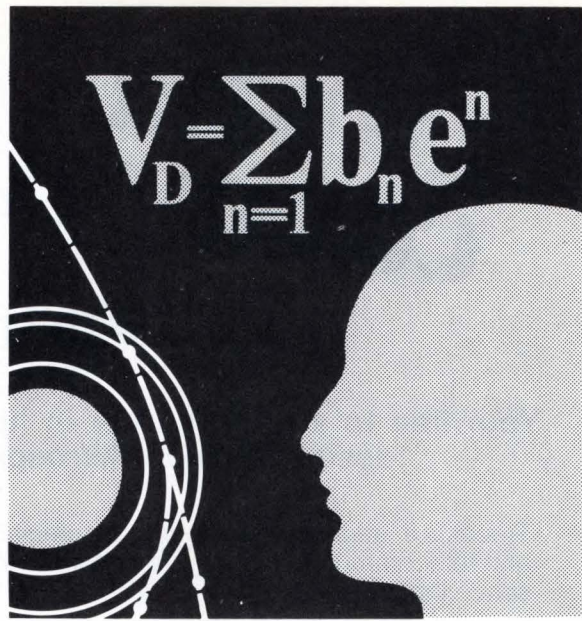
Tactical Systems Engineers — Perform software definition and specification for advanced tactical C³I systems. Involves development of functional requirements, definition of top-level designs for system software and evaluation of alternative processing of algorithms. Requires top-down structured design experience and knowledge of operating systems. Prefer technical degree with 7 years of related experience. Contact Jerry Chadwick.

Signal Processing Engineers — Digital signal processing design, including TTL and CMOS logic plus interface with the M68000 microprocessor. Also involves analog design and high order language programming. Contact Jerry Rule.

Communications Engineers — Experienced in design and development of communication systems utilizing digital signal processing, spread spectrum, forward error correction and other advanced modulation/demodulation concepts. Prefer MS/PhD. Contact Dotti Morris.

Magnetics Design Engineers — Experience in the design of magnetic components for military and aerospace applications and in the design and construction of transformers and inductors operating in the 20-100 KHz range. Prefer technical degree with 3 years experience. Contact Gary Yost.

Sensor Development Engineers — Experienced in the design, modeling, analysis and hardware development of electro-optic sensors for missile fuzing devices. Background should include laser radar and passive detection. Will prepare white papers and proposals. Contact Jerry Rule.



Test Equipment Design Engineers — Responsible for development of computer controlled test equipment. Knowledge of analog and digital design as well as overall system theory. Prefer BSEE and 3 years experience with FORTRAN and IIP computers. Contact Paulette Dorris.

Join the people of Motorola's Government Electronics Group. The benefits are many, including sunny Arizona — a land as beautiful as it is booming with recreational and cultural outlets. For more information, send your resume in confidence, or call the appropriate technical recruiter collect at (602) 949-3759. Motorola Government Electronics Group, 8201 E. McDowell Rd., Dept. B195, Scottsdale, AZ 85252.

An Equal Oppty/Affirmative Action Employer
U.S. Citizenship Required



MOTOROLA INC.

Government Electronics Group

An Equal Oppty/Affirmative Action Employer
U.S. Citizenship Required

"We are involved in the challenging kind of work that is well suited to an engineer who wants to build a career."

Ray Waddoups

CHIEF ENGINEER, Tactical Systems Office

The Mind to Imagine
THE SKILL TO DO

THE AUSTIN CONNECTION

(512) 929-2071

Your line to a great career in high frequency design at Tracor Aerospace.

Tracor is a leading manufacturer of specialized electronics and telecommunications systems for the international aerospace industry.

In the past three decades, we've grown from a five-man R&D firm, to the only Fortune 500 Company headquartered in Austin, Texas.

It's a claim we're proud to make. Because, to us, it means success.

To you it means accessibility. To company resources. And top management. It means being at the very heart of corporate operations. Instead of miles away in a satellite office or a manufacturing plant.

Right now, we're looking for engineers who share our progressive spirit. Specific opportunities exist for:

**AMPLIFIER DESIGN ENGINEERS
ANTENNA DESIGN ENGINEERS
MICROWAVE ENGINEERS
RF DESIGN ENGINEERS
ELECTRO-OPTIC ENGINEERS**

If you have experience designing high frequency systems (six MHz and above) and integrating them into small packages, please contact us today.

Call Chuck Wehling or Jim Geanuleas, collect, at (512) 929-2071. We're eager to tell you about working at Tracor and living in Austin, a city that offers a thriving technological business climate and one of America's finest environments for living and raising your family. And Austin's affordable, too—we have no state income tax!

Austin is the State Capitol and home of the University of Texas, the fourth largest educational institution in the country. And it's a great place for outdoor recreation: Hiking and hunting in the Hill Country, or sailing and water skiing on surrounding freshwater lakes.

Naturally, Tracor offers competitive salaries and an excellent benefits plan.

Find out more. Call today. Or send us your resume, write: Professional Staffing/Tracor Aerospace/6500 Tracor Lane/Dept. T-11/Austin, Texas 78721.

Tracor Aerospace

U.S. Citizenship Required
Equal Opportunity Employer M/F

H/W & S/W Engineers & Managers
Our clients have need for your background. Please send resume to:
SN SEARCH NORTHWEST ASSOCIATES
Ports O'Call-Swan Island
4505 N. Channel, Portland, Oregon 97217
Phone: (503) 288-6560
Keith Nyman or Doug Jansen
All Fees Employer Paid

Nationwide Openings in
Defense, Electronics, Telecomm Com-
munications, ATE, Avionics, MIS, Hard-
ware/Software, Aerospace, Computer
Systems & Prog, QA/QC, CAD/CAM,
VLSI/LSI

ALL FEES COMPANY PAID
William Bell
CAREER OPPORTUNITIES INC.
734 Walt Whitman Road
Melville, NY 11747
(516) 549-0425

**HOW
TO
PLACE
YOUR AD**



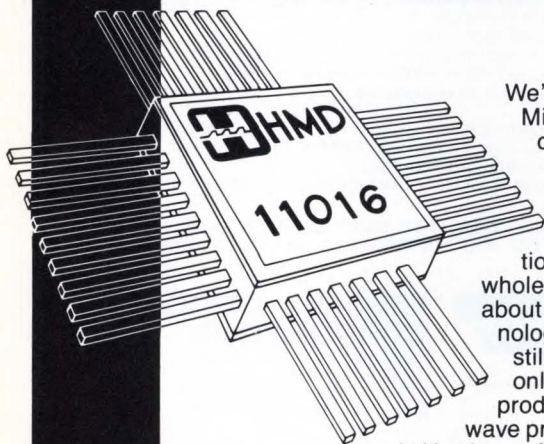
**CALL THE
RECRUITMENT
HOT LINE**

Camera-ready film (right reading negatives, emulsion side down) or camera-ready mechanicals must be received by deadline. Or, if you wish us to set your ad (typesetting is free) simply pick up the phone and call our RECRUITMENT HOT LINE—(201)393-6000/6076
Ask for:

Gail Goldstein
Recruitment Advertising
Manager
10 Mulholland Drive
Hasbrouck Hts., N.J. 07604

Engineers

What will the people who introduced the world's first commercially available Gallium Arsenide Digital ICs do next?



We're Harris Microwave Semiconductor, a rapidly growing division of the \$2 billion, Fortune 200 Harris Corporation. We started the whole industry talking about our GaAs IC technology and they're still talking . . . not only about our GaAs products but our microwave products as well.

At Harris, you'll find this kind of innovative spirit in both our new product development and management philosophy. We're involved in creative technologies that most engineers just dream about. Right now we have several exceptional opportunities:

Senior Amplifier Product Engineers

A BSEE and 5-8 years experience in Amplifier Product Engineering are required to troubleshoot product, reliability and special program problems back to the process in MIC Fab, Assembly and Test. You must be a team player and have excellent analytical skills to characterize products, and to evaluate, design and implement productivity improvement programs. U.S. citizenship is required.

Product Development, Circuit Engineers

A BS or MSEE with at least 3 years experience in high frequency (Microwave) circuit design is required as is a solid background in GaAs FET circuit matching in MICs or MMICs. You will characterize and design multiwatt FET devices and future integrated microwave products up to product release. U.S. citizenship is required.

GaAs Materials Engineers

An MS in material science (PhD preferred), and a strong background in solid state physics and engineering, including coursework in device physics, are required to determine the relationship between material properties and device performance. Responsibilities include coordinating crystal growing and device experiments and establishing proper measurement techniques.

Field Applications Engineers (In bipolar IC and FET areas)

Primary responsibilities will include analyzing customer applications questions and problems, and formulating product solutions. For our IC product line, 2 years experience designing high speed bipolar ICs or microwave systems is required. In the FET area, we require 2 years hardware designing experience using GaAs FETs. A BSEE is essential for both positions, as is strong interpersonal and communication skills and a willingness to travel to customer sites.

Microwave Technicians

Assist in the development and prototype shipment of microwave amplifiers and operate automatic test system and other measurement equipment. A minimum of 2 years related experience and U.S. citizenship are required.

Along with providing opportunities to advance in your career, we offer an excellent salary and benefits package. To apply, send your resume to Jean Pridgen, Supervisor Human Resources, Dept. ED1031, Harris Microwave Semiconductor, 1530 McCarthy Blvd., Milpitas, CA 95035. We are an equal opportunity employer M/F/H/V.

For more information, please see our product ad in this issue.



HARRIS

IF IT'S HAPPENING IN ELECTRONICS,
IT'S HAPPENING AT HARRIS.

FEDERAL EXPRESS... INTRODUCING NEW TECHNOLOGY IN IMAGE TRANSMISSION.

Federal Express has opportunities for you to work with our absolutely, positively, incredible technology. Rapid growth of our Electronic Products and Satellite Systems Divisions has created the need for the following individuals:

Senior Manager Network Support

You will monitor, maintain and operate unique communications facilities for the ZapMail network; manage a large staff of professional and technical support personnel coordinating the installation, maintenance, and repair of communications equipment as well as managing circuit administration, node installation, and network analysis. A Bachelor's degree or the equivalent experience in Electronic or Electrical Engineering and a minimum of eight years experience in telecommunications, systems maintenance, repair and diagnostic evaluation is required. Five years previous management experience encompassing high technology communications analysis, operations and control as well as experience in managing a large staff is preferred.

Manager Of Network Operations

This position requires technical knowledge and the ability to handle people in a high tech environment. Your staff will include Datacommunications and Telecommunications Specialists. A Bachelor's degree in Computer Science or Electrical Engineering and six years experience in Datacommunications hardware and software systems is required. Experience in Network Operations or Technical Control with strong planning skills and previous management of a large staff is preferred.

Technical Advisor

You will provide technical input and manage the procurement process of the space-based and ground-based components of the satellite communications network. You must have a BS in Engineering with six years experience in satellite communications development and operation. Experience in proposal preparation, evaluation and contract management is preferred.

Technical Advisor-Product Specification

You will be responsible for conceiving, defining, and developing technical specifications and operational procedures for new electronic communication products and services; assessing state-of-the-art technologies and coordinating new product specifications with technology specialists and external hardware/software vendors. A Bachelor's degree in Electrical or Electronic Engineering, Math, Physics or Computer Science and seven years professional experience in technical development of electronic information products and services is required. MBA, project management and international experience is preferred.

These are opportunities for you to work with a company on the leading edge of high technology. Federal Express offers a highly competitive benefits package. Please rush a letter indicating your experience and salary history. (Include your resume if you have one.)

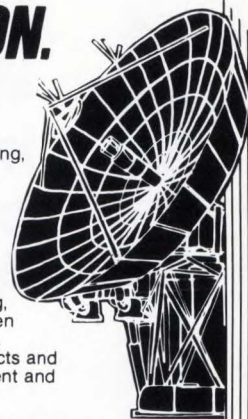
FOR CONSIDERATION, YOU MUST CLEARLY INDICATE THE POSITION YOU ARE INTERESTED IN ON YOUR REPLY ENVELOPE.



FEDERAL EXPRESS CORPORATION

Electronic Products Division
Satellite Systems Division
P.O. Box 727, Dept. 3514-421
Memphis, TN 38194

Equal Opportunity Employer M/F



Job function
74% of Electronic Design readers
work in design and development.

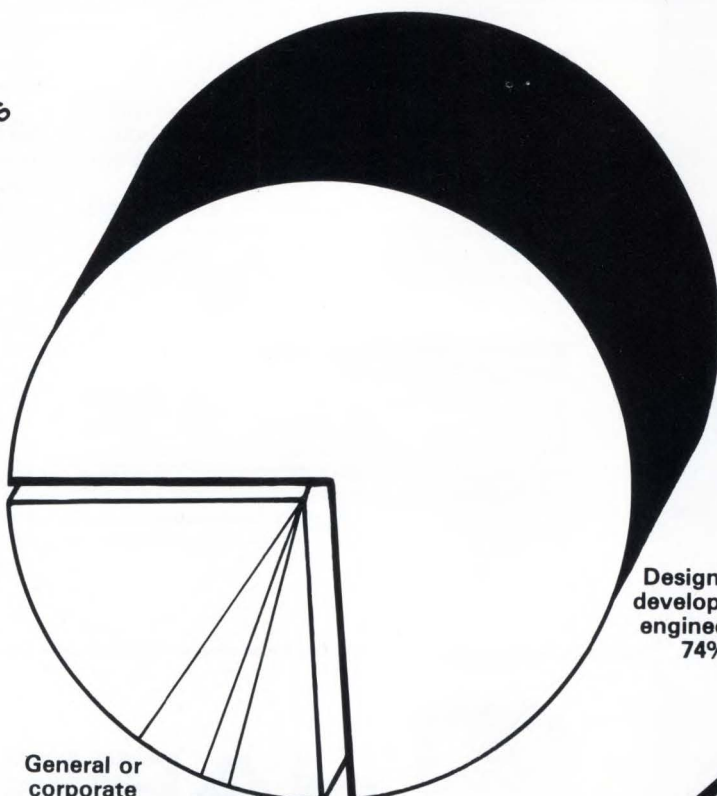
Engineering
services
16%

General or
corporate
management
4%

Basic
research
1%

Manufacturing and
production
4%

Design and
development
engineering
74%



Big ads equal big savings

The regular
or ROP rate
for
Electronic Design's
full page
black and white unit
is
23% greater
than the
special rate for
recruitment advertising.
By using a full page,
advertisers get
important positioning,
frequent domination
of the spread —
and significant
cash savings.
Small-space classified
display ads
are a bargain, too,
but nothing
can match
full pages for
full impact.

Gail Goldstein
Recruitment
Advertising Manager

ELECTRONIC DESIGN
10 Mulholland Drive
Hasbrouck Heights, N.J. 07604
(201) 393-6000/6076

At Last . . . A High-Tek Project Equal To Your Expectations

Logic Design Systems In Oregon

Imagination, innovation and ingenuity are the hallmarks of the Tektronix EE-CAD/ CAE environment. You can feel the excitement . . . the challenge and promise of success, backed by the support of an established, successful company.

LDS is developing a new mainline Tektronix business — the software and hardware tools that offer the most versatility and highest performance for CAD and CAE applications.

Software Engineers

Match your own expertise with one of these exciting, aggressive projects in Tek's outstanding IC-CAD environment:

- **Simulation**
- **Compilers/Linkers**

Expertise in compiler development, linker/loaders, concurrent processing, data structures and software evaluation could put you on this team.

- **Symbolic Layout**

Lead a project to develop advanced symbolic layout tools for multiple technologies.

- **Module Generator**

Define, develop and integrate automatic module generation capability into a comprehensive CAD system.

- **Accelerator Firmware**

Implement a CAD/CAE application at a low level on our unique hardware architecture. Design and coordinate low-level and high-level software.

- **Graphic Editors**

Develop high-performance layout and schematic editors running on sophisticated proprietary Tektronix hardware.

- **Cell Libraries**

Define and develop methods and software for translating and supporting gate array and standard cell libraries.

Marketing & Sales

- **Product Marketing
Managers**

Experience with the introduction and marketing of computer-based systems products. Knowledge of computer-aided electrical engineering processes and techniques.

- **Sales Engineers**

Knowledge of the IC design and fabrication process as well as the products available to this industry. Selling expertise related to computer-based system products.

- **Applications
Engineers**

Successful experience providing factory or field-based technical support and consultation for computer-based systems.

Tektronix is a Fortune 500 leader in the incomparable environment of the Pacific Northwest. Send your resume to Human Resource Manager, Tektronix, Inc., Logic Design Systems Division, P.O. Box 4600, MS-92-830, Beaverton, OR 97075.

Equal Opportunity Employer

Tektronix®

COMMITTED TO EXCELLENCE

Electronic Design's
recruitment newspaper
is **now** reaching
195,000 engineers
professionally and personally
on the move

1985 CAREER EXTRA ISSUES TO GO MONTHLY!

A black and white photograph of a man with dark hair, wearing a striped shirt, holding a newspaper in front of his face. The newspaper is titled "Electronic Design career EXTRA" in large, bold letters. The man's eyes are visible above the top of the newspaper. The newspaper itself contains several articles with headlines and text columns. The overall image is framed by a thin black border.

Electronic Design
career
EXTRA

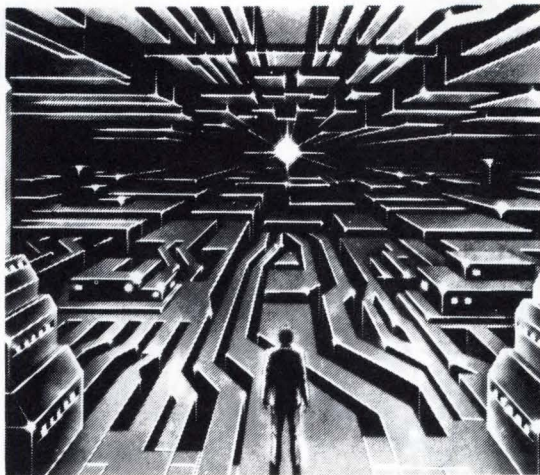
Small teams capitalize on the versatility and expertise of EEs.

1980 picture strong despite recession talk

Professionals' salaries will soar in '80s

Defense contracts see increasing demand for EEs

INTEL...HAVING A VISION.



MAKING IT HAPPEN.

Our leadership is a result of our technology...that's how the VLSI revolution came about, here at Intel. Our standard setting microelectronics developments include the first RAM, EPROM, microprocessor, single-board computer, microcomputer development system, and million-bit bubble memory. We also originated CMOS and HMOS technologies, and we will continue to set the standard in the next generation of advanced microprocessors, memory devices and microcontrollers. Intel professionals have vision, desire, convictions and discipline to lead...do you?

VLSI COMPONENT DESIGN ENGINEERS

Design new high-integration, high-performance CMOS microprocessors or peripherals. Responsible for microarchitecture, simulation, chip and circuit design, chip planning, layout supervision, Sentry and bench level test verification on CMOS/NMOS products within Intel's Peripheral or Microprocessor Groups. BS/MSEE and 2+ years experience

ADVANCED MEMORY DESIGN ENGINEERS

Responsible for the design and characterization of advanced memory products, including DRAM, E²PROM, Static RAM and Magnetic Bubble Memories. Responsibilities include all phases of logic design, circuit design, characterization and transfer. BS in Engineering Sciences, MS preferred and 2 years experience.

SYSTEMS CAD (Oregon)

This area encompasses functional and physical aspects of board and system-level products. This includes functional through gate-level simulation, testing and test generation, and automatic placement and routing for boards.

FUNCTIONAL/PHYSICAL DESIGN CAD

We are seeking CAD professionals with logic and fault simulation, behavioral modeling and mixed level simulation for our Functional Design area. Our Physical Design area requires expertise with layout synthesis including sticks, place and route, cell compilers as well as post design tools including pattern generation and frame generation. CAD and workstation experience desired.

PRODUCT DEVELOPMENT ENGINEERS

Individuals to be responsible for test program development, yield/cost analysis, product characterization and new product introduction for Intel's Memory Component, Microprocessor or Peripheral Products Groups. BS, MS or PhD in Engineering Sciences with 2+ years experience in MOS/CMOS processes and experience with Sentry, Teradyne or Megatest testers required.

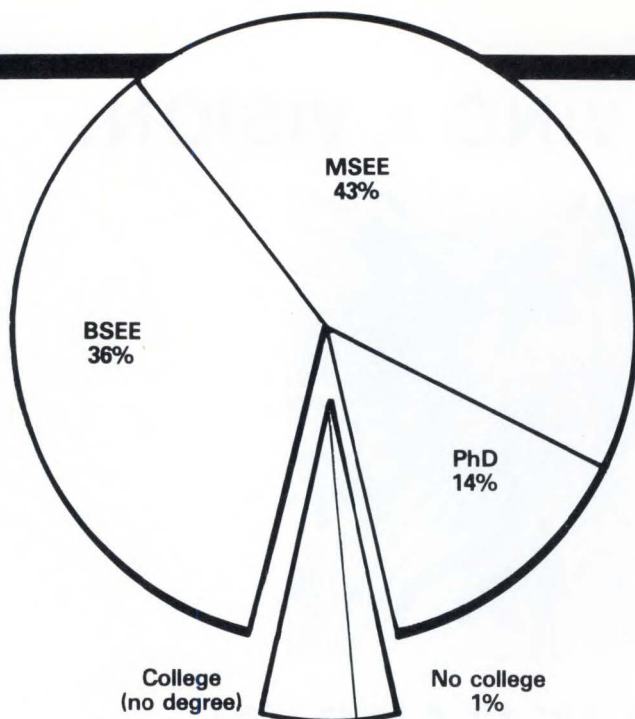
Dedicated professionals are now extending our technology into a growing family of components for the future. If you have vision, we'll help you make it happen. For consideration, send your resume to the locations that interest you c/o Intel Employment, Dept. 4436: **Phoenix, AZ**, 5000 W. Williams Field Road, Chandler, AZ 85224; **Santa Clara, CA**, P.O. Box 2546, Santa Clara, CA 95051; **Folsom, CA**, 151 Blue Ravine Road, Folsom, CA 95630; **Albuquerque, NM**, 4100 Sara Road, Rio Rancho, NM 87124; **Portland, OR**, 5200 N.E. Elam Young Parkway, Hillsboro, OR 97124-6497. An Equal Opportunity Employer M/F/H.

"Intel is proud to introduce our new facility in the beautiful and affordable Sacramento Valley."

intel[®]

Education

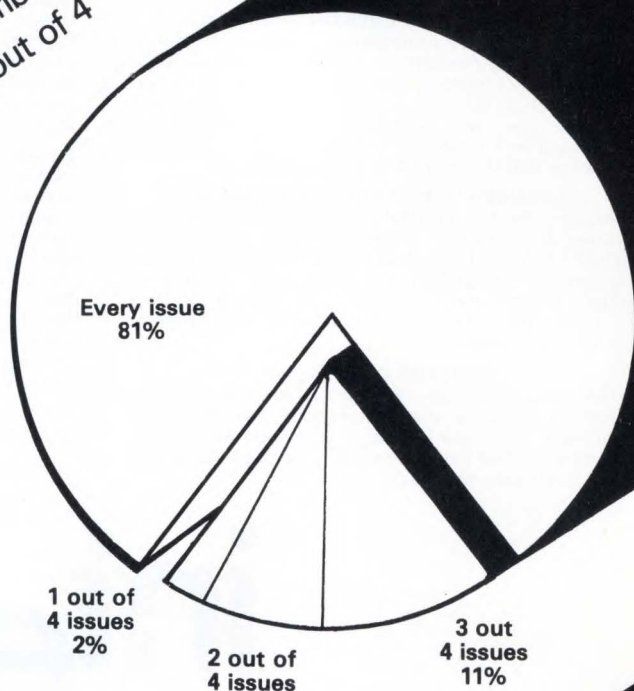
93% of Electronic Design readers have a college degree. 57% have a postgraduate degree



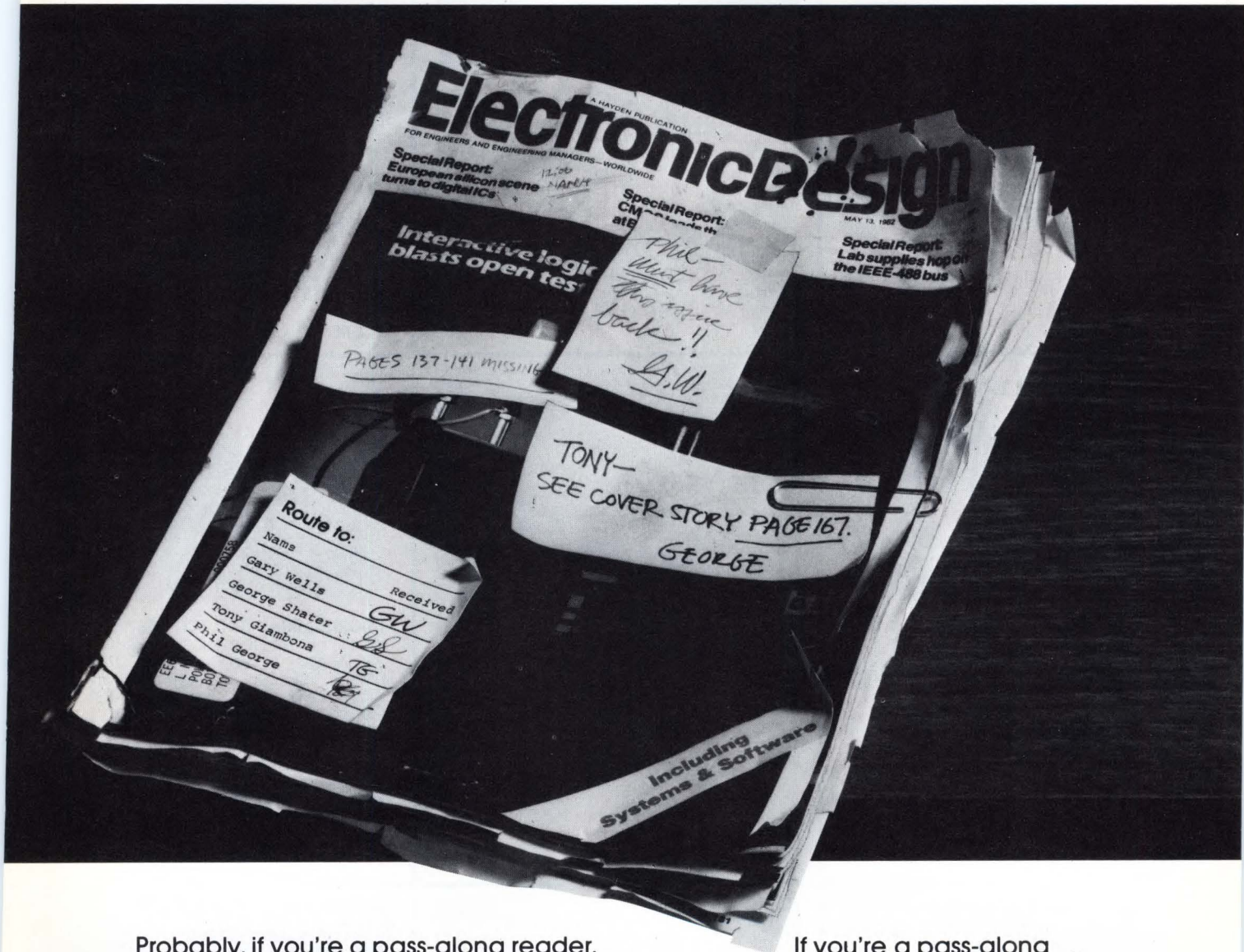
Readership

81% of Electronic Design subscribers read every issue. 92% read 3 out of 4 issues

Read Electronic Design:



Does your copy of **ElectronicDesign** ever look like this?



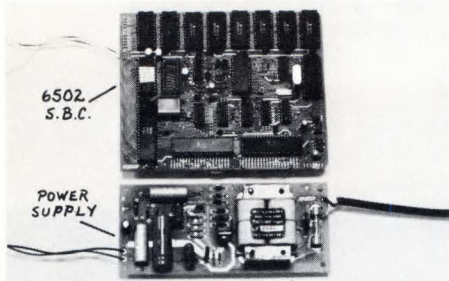
Probably, if you're a pass-along reader. Which means you're getting the latest new technology information secondhand.

Take our cover stories, for example. Each cover story delivers the first design details of an important new product or technology being announced exclusively in *Electronic Design*.

Or a major staff-written report, followed by a comprehensive package of related articles by-lined by leading authorities at important design centers.

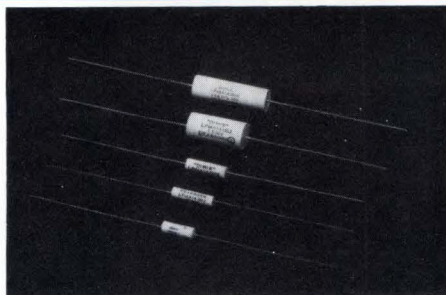
If you're a pass-along reader, why not be second to none? By subscribing to *Electronic Design*, you'll receive 26 issues of the latest new technology, products, and applications. Every time. On time.

There's a subscription card bound in this issue. Send it in today. Because the time it takes other readers of your next copy to sift through and evaluate the latest industry breakthroughs may be all the time your competitors need.



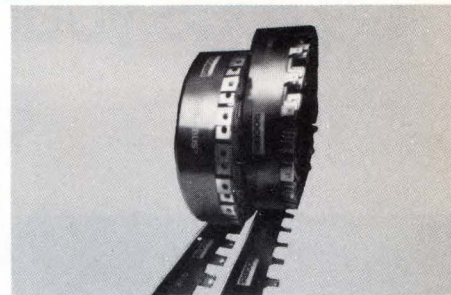
6502 SINGLE BOARD COMPUTER with 16K CMOS RAM, sockets for two 2532 EPROM 8K. Real time calendar clock using MM58167, one RS232 serial port using a 6551ACIA and four parallel ports using two 6522VIA. Uses a single 5 volt power source at 600MA, 5.5 x 7 inches. Assembled and tested. \$389.00. 5 volt, 1 amp **SWITCHING POWER SUPPLY** with floating battery backup circuit. Input 115VAC or 10 to 15VDC, 3 x 7 inches PCB. Assembled and tested. \$79.00. **Custom Programming Group, Inc.**, 47-2A Marchwood Road, Exton, PA 19341. (215) 363-8840.

CUSTOM PROGRAMMING GRP., INC., 255



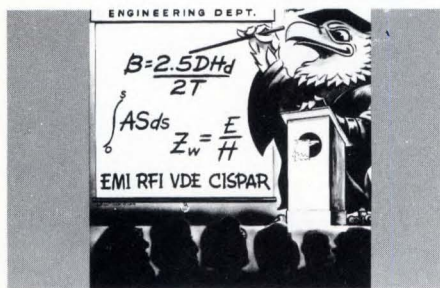
METALLIZED POLYCARBONATE-FILM CAPACITORS. Dearborn Type LP66 Deltafilm® 'LP' capacitors offer high volumetric efficiency, exceptional capacitance stability, superior reliability at moderate cost. Low dissipation factor (high Q), low temp coefficient of capacitance, high insulation resistance. Operate at -55°C to +125°C w/out voltage derating. Capacitance values, 0.1µF to 22.0µF. Capacitance tolerance to ±1%. Voltage ratings, 50-400 WVDC. Write for Bulletin DB-125B. Sprague Electric Co., 347 Marshall St., North Adams, MA 01247. (413) 664-4411.

CAPACITORS 256



THE 'QUIK' SOLUTION TO BUS BARS. QUIK/BUS® conductors from Rogers take the waiting and the tooling cost out of bus bars. Easily assembled in the exact configuration you need, they come in reels of insulated plated conductors with multiple tabs. Featuring greater reliability than wiring harnesses, QUIK/BUS also offers lower installed cost plus easier, error-proof installation. Send for our free do-it-yourself brochure. Rogers Corporation, Bus Products Division, 5750 East McKellips Road, Mesa AZ 85205. 602 830-3370.

ROGERS 257



EMI PROBLEMS? Let Eagle Magnetic solve your magnetic shielding problems! For more information write or call: Eagle Magnetic Co., Inc., P.O. Box 24283 • Indianapolis, Ind. 46224 Phone (317) 297-1030.

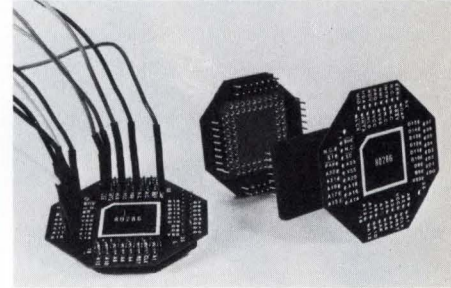
MAGNETIC SHIELDING PROBLEMS 258



At last! A feature-packed computer with 256K RAM, Winchester and Video Controllers
Introducing the New Quark from Megatel

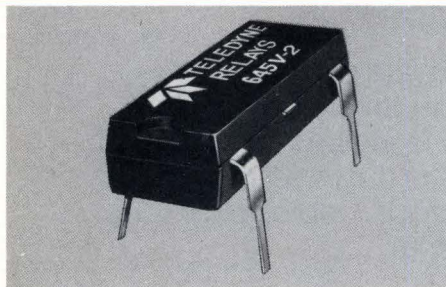
Save time & cost of hardware design & integration w/Megatel's Quark. HARDWARE: • 6 MHz Z80; • ST-506 Hard Disk & Floppy Disk Controllers; • 2 Serial Ports; • 4 Parallel Ports; • 128K/256K RAM; • Graphics/Alpha Video Controller; • I/O & EPROM Expansion; \$495 in OEM Qty. **SOFTWARE:** • Ready To Boot Up; • Floppy & Hard Disk Drivers; • Peripheral Hardware Independent; • Fully User Configurable; • Graphics/Alpha Terminal Drivers; • Source Code Provided; • CP/M 2.2 & 3.0. **Call Today! Megatel**, 1051 Clinton St., Buffalo, N.Y. 14206. 416-745-7214.

MEGATEL QUARK BOARD 259



PIN-GRID-ARRAY AND LCC TEST CLIPS. The bug catcher II™ offers the first reliable method for debugging software and hardware for your iAPX186, iAPX286, 68000, 68010 and other 68 pin PGA packages. The fully labeled overlay plate complete with the mnemonics for your processor, eliminates the time spent referring to data sheets or counting pins. Bug catcher is also available for popular microprocessors packaged in 40, 48, or 64 dual-in-line pkgs. **EMULATION TECHNOLOGY, INC.** 422 Ives Terrace, Sunnyvale, CA 94087. (415) 960-0652.

PIN-GRID-ARRAY AND LCC TEST CLIPS 260



LOW EMI AC DIP SOLID STATE RELAY Teledyne's 645V meets FCC and VDE stds. Features 3.8 to 32V input and TTL logic compatibility, up to 1 amp switching at 250VRMS, back to back SCR output, low leakage current of 1mA RMS, 3750VRMS VDE level optical isolation, low insertion factor of ± 1.5V, high noise immunity, and virtually no switching transients. \$4.90 ea for 5000 pcs. Teledyne Solid State Products, 12525 Daphne Ave., Hawthorne, Ca. 90250 (213) 777-0077.

RELAYS 261



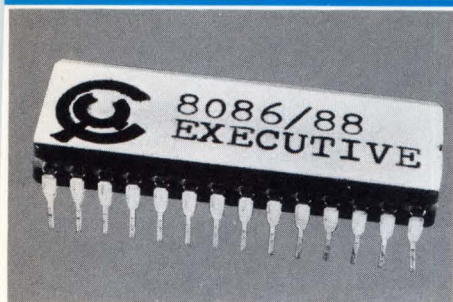
ACCURATE DATACOMM TESTING IS EASY with new tri-state LED display of red, green and mixture (orange). The unique Model 700 EIA RS-232 Interface Analyzer utilizes tri-state LED's to clearly display polarity, activity, and validity of all key interface signals simultaneously. 24 mini-switches allow signal isolation and testing. Includes minipatchcords. Battery powered, ideal for computer room or field service use. On GSA schedule. Immediate delivery: Electro Standards Laboratory, Inc., Box 9144, Providence, R.I. 02940 (401) 943-1164.

DATA INTERFACE ANALYZER 262



SIMULATES DIGITAL DATACOMM LINK for unit, system, and network performance checks and troubleshooting. Select a burst error rate of .5 to 10⁻⁹ with 1-999 errors per burst. Digital noise source generates statistically random errors. Replaces Gaussian source, filters and mixers. Operates 1 bps to 10Mbps. RS232 & RS422 interfaces opt. **GENERAL DATA PRODUCTS** (215)-572-5858. 310 Cottman St., Jenkintown, PA 19046. \$2520 qty 1-5.

MODEL 106 LINK SIMULATOR 263



MICRO-CRAFT ANNOUNCES A MAJOR BREAK-THROUGH in a portable software emulator. The micro-craft 8086/88 debug executive is a versatile development/debugging tool. Prom resident in 3.5K of memory with 1/2K memory for the user. Features: go, call, trace, and 5 breakpoints. Substitute/display: memory, registers and I/O ports. Also, load & save memory. (Line disassembler) Micro-craft P.O. Box 33236, Los Gatos, CA 95031 (408) 978-7831.

SOFT EMULATOR

264



CRT ANODE CONNECTORS Alden offers a complete line of low cost, high quality anode connectors. These low profile connectors operate to 40 KVDC and meet U.L. flame specs. New 6 prong contact insures a positive connection plus easy removal and installation. Available for field assembly or integrally molded to wire for maximum insulation. ALDEN PRODUCTS CO. 117 N. MAIN ST., BROCKTON, MA. 02403. 617-583-0160.

CONNECTORS

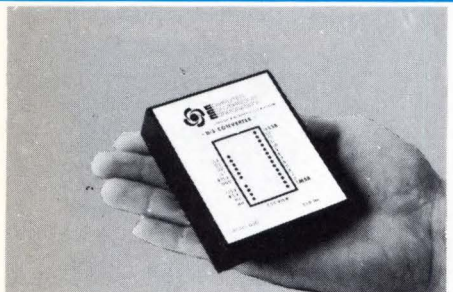
265



The **NEW OMEGA SLC-II** is a "stand-alone" computer voice simulator. The SLC-II will monitor any RS232C data stream, analyze the information and route it through any of 16 possible outputs to a data bank, computer terminal, or even call & brief you directly via the phone. Eighty-five actions can be stimulated over the phone. Programming is done in B/SIC. For information in a RUSH, call (203) 359-7874. OMEGA ENGINEERING, INC., P.O. Box 4047, Stamford, CT. 06907.

SLC-II TALKING MONITOR

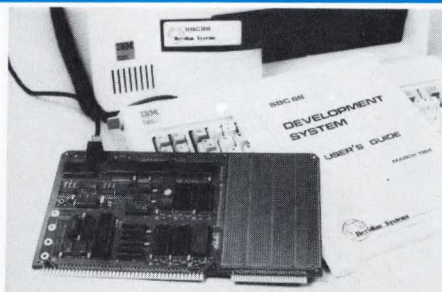
266



DIGITAL TO SYNCHRO CONVERTERS .6" HIGH - 14, 12 or 10 bit input, 11.8/90V, 400 or 60Hz transformer isolated output, accuracy ± 4 , ± 15 or ± 30 min. Driving 1 VA, 2VA (2.6" $\times$ 3.1" $\times$.6" H module) or 5 VA loads (4 1/2" $\times$ 9 1/4" PC card). Price from \$350 in qty. Other CCC products are Synchro to Digital or DC, and DC to Synchro Converters, Solid State C.T.'s or CDX's, and Absolute Encoders. Send for Free Catalog & Application Notes. Computer Conversions Corp., East Northport, N.Y. 11731 (516) 261-3300.

DIGITAL TO SYNCHRO

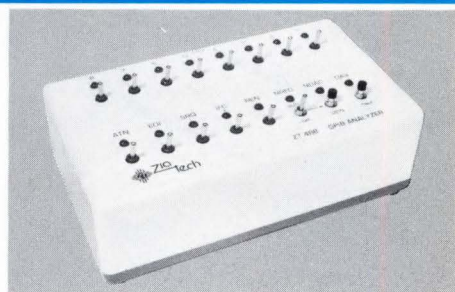
267



IS the IBM PC a DEVELOPMENT SYSTEM? YES!!! For only \$600 you get: 8088 Single Board Computer (SBC88) + Development Software + Cable (SBC88 to PC) + Documentation. Applications include: Robotic Design, Process Control and Automation, Education, Dedicated Testers, Lab Application, Prototype Designs, etc. Also available: PROM PROGRAMMER, PAL PROGRAMMER. PC Software included. **MERIDIAN SYSTEMS** 321 Aviator St., #111, P.O. Box 3034, Camarillo, CA 93011; (805)-484-8696.

SBC88 DEVELOPMENT SYSTEM

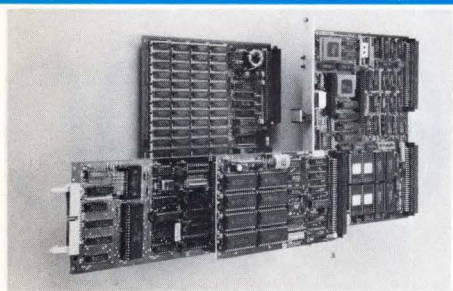
268



IEEE-488 LOGIC ANALYZER provides the capability to monitor as well as control IEEE-488 devices. The ZT 488 can also simulate devices that are under development and save time and money on GPIB debugging and trouble shooting. Price: \$595 (\$495 when purchased as an option to any Ziotech GPIB product). **ZIATECH CORPORATION**, 3433 Roberto Court, San Luis Obispo, California, 93401, U.S.A. (805) 541-0488, ITT telex #4992316.

ZT 488 LOGIC ANALYZER

269

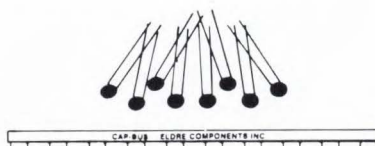


VME 68000 FAMILY MODULES Full MOTOROLA compatible but reinforced 8MHz/10MHz CPU modules with battery backed-up RTC & on-board CMOS RAM, 512KB and 2MB DRAM memory modules. Static 64KB RAM, ROM, Floppy I/F, Hard Disk I/F, Serial I/F modules. **AMPERE, INC.** Asahi Bldg., 5-chome, Nishi-Shinjuku, Shinjuku-ku, Tokyo Japan Telex J33101 AMPERE PHONE 03-365-0825.

CPU MODULES

270

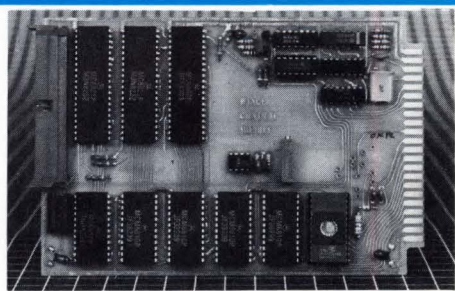
ELIMINATE DECOUPLING CAPACITORS



CAP-BUS® CAPACITOR/BUS BAR Eliminate the decoupling capacitors and the power and ground traces from your PCB for more reliability. CAP-BUS® has distributed capacitance of .05 micro-farads per lin. in., at 50 VDC with low inductance and low impedance. The capacitor and the bus bar have been joined together for CAP-BUS®; a more efficient capacitive decoupled power distribution system, increasing IC density on a two sided board. **ELDRE COMPONENTS, INC.**, 1500 Jefferson Rd., Rochester, NY 14623 (716) 244-2570

BUS BAR CAPACITOR

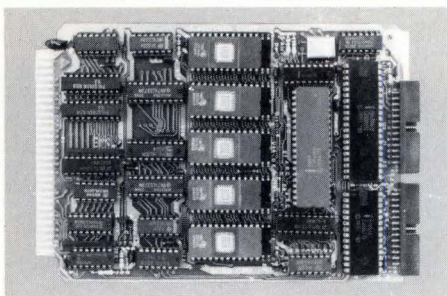
291



\$91.00* Single Board Computer. *500 piece price, model MCL45 (shown). 6800 MPU, serial I/O, parallel I/O, RAM, EPROM, 44-pin 4.5" $\times$ 6.5" PCB. EXPANSION MODULES: RAM, EPROM, CMOS RAM/battery, analog I/O, serial I/O, parallel I/O, counter/timer, IEEE-488, EPROM programmer, floppy disks, cassette, breadboard, keyboard/display. **Wintek Corporation**, 1801 South Street, Lafayette, IN 47904-2993. (317) 742-8428.

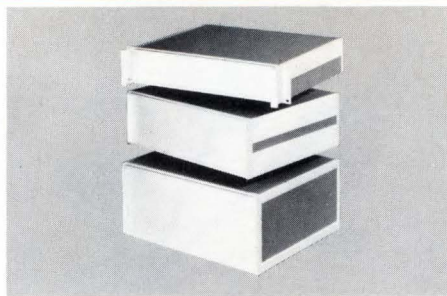
SINGLE BOARD COMPUTER

272



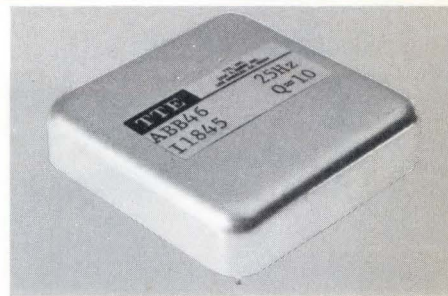
16-BIT SINGLE BOARD STD COMPUTER. The RSD-8088 features a 16 bit 8088 running at 4.77 MHz, RS-232 serial I/O chan. w. prog. baud rate, 20 prog. parallel I/O, 5 28 pin bytewise memory sockets with read/write capability for EPROM, additional 256 bytes RAM, wait state gen., on-board interrupts, prog. memory and I/O map decoder, 1 megabyte memory and 64K I/O ranges, full STD bus compatibility. Dealer inquiries welcome. ROBOTROL CORP., 16100B Caputo Drive, Morgan Hill, CA 95037.

16 BIT STD MICROCOMPUTER 273



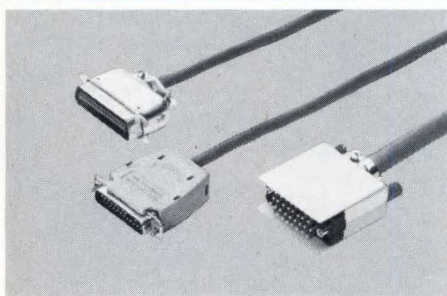
BUCKEYE STANDARD INSTRUMENT ENCLOSURES are in three distinctive styles, six heights, four widths and four depths. Designed with aluminum extrusions and painted or vinyl-clad aluminum panels for beauty and functional packaging. Modifications, prices and full specs will be sent in a new brochure. Contact: Buckeye, R.E. Osborne, 555 Marion Rd., Columbus, OH 43207. 614-445-8433.

STANDARD CASES 274



Active Filters: T T E filters include these features: * A choice of single or dual supply voltages; +5VDC to +15VDC or ±5VDC to ±18VDC. * A wide range of frequencies; 10Hz to 200KHz * Butterworth or Tschebysheff designs; 2-10 poles * Miniature PCB packages. Also available from T T E are PASSIVE FILTERS. Please contact us with your specification. TTE, Inc., 11650 W. Olympic Blvd., Los Angeles, CA 90064, (213) 478-8224.

FILTERS 275



EIA AND 200 OTHER INTERFACE CABLES— Call on Data Set Cable for all types of cables and connectors, many in stock for immediate shipment ... or order pinned to your specifications: ribbons, coax, twin-ax, TELCO, compatibles for IBM, DEC, H-P ... to name just a few. EIA RS-232C cables—25 conductors, all connected, \$16 plus 50¢/ft. Send for catalog. Data Set Cable Company, 722 Danbury Road, Ridgefield, CT 06877—(203)438-9684. Also Las Vegas—(702)382-6777.

DATA SET CABLES 276



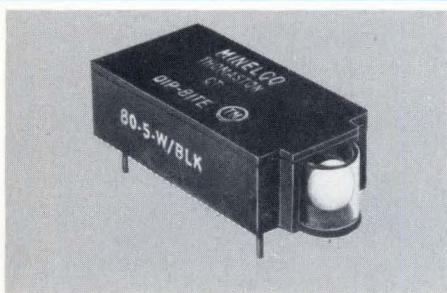
GTEK's Model 7228 (E)EPROM Programmer features Intelligent Programming Algorithms and supports the newest devices available through 512 Kbits and programs 6x as fast as standard algorithms. The 7228 programs the 2764 in one minute! It supports Intel 2764A and 27128A chips. It also supports Tektronics, Intel, Motorola and other formats. Priced at just \$549. GTEK, Inc., P.O. Box 289, Waveland, MS 39576; 601-467-8048.

EPROM PROGRAMMER 277



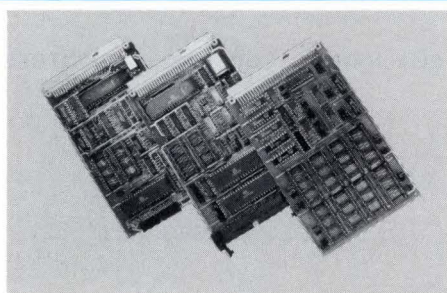
Available for Immediate Delivery. 15" monitor housings of UL VO 94-95 materials. Bezel has molded bosses to allow direct mounting of tube, saving on wire frames. ONLY \$76.99 each for 1-100 quantity. Custom fabrication, EMI/RFT shielding and painting available. Other sizes of monitor housings plus keyboard housings, also. Hettinga, Inc. 2123 N.W. 111th St., Des Moines, Iowa, 50322 U.S.A. Telephone 515-270-6900. Telex 478315.

MONITOR HOUSINGS 278



DIP-BITE LATCHING INDICATOR New magnetically-latching fault indicator with low-profile PC mount, for commercial and industrial applications. Responds to a 100 ms pulse, remains latched without additional power until reset. Highly visible black/white indicator. Low-profile, long-life, non-volatile, environmentally-sealed, with 4 pins .300 x .500 oc. Prototypes available. Minelco, Inc., 135 South Main St., Thomaston, CT 06787. Phone 203-283-8261. TWX 710-475-1091. See us at Wescon, Booth #1756-1758.

LATCHING INDICATOR 279



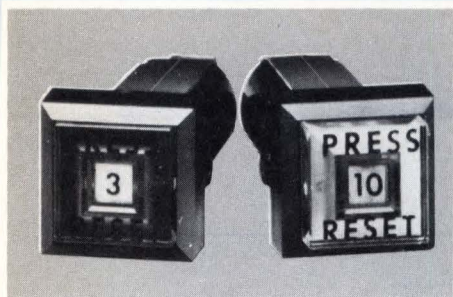
HI-SPEED CMOS MODULES CMMS series Eurocard size high speed CMOS microcomputer modules including 5MHz CMOS 1802B 8-bit CPU Modules, 64K memory modules, realtime clock w/ battery backup, UARTs, parallel I/Os, & EPROM programmer modules, operating up to +85°C. 64-way DIN connector buss ensures high system reliability. Microtronics Systems, 8 Lorong Bakar Batu, #03-01 Kolam Ayer Industrial Park, Singapore 1334. Telex RS 34929 MICRO.

CMOS MODULES 280



Portable Qelco 68000 Assembler Package. Features: conforms to Motorola resident Assembler, macros, structured programming directives, 68010 instructions, relocation and linking, object librarian, symbol report generator, various HEX load formats, readily transported to any system with a C compiler. Ready to run under CP/M-80, -86, -68K, MS-DOS and PC-DOS \$595. Portable source \$750. Call or write Qelco 2464 33rd W. suite 173, Seattle, WA 98199 (206) 285-2528. Telex II (TWX) 9103338171.

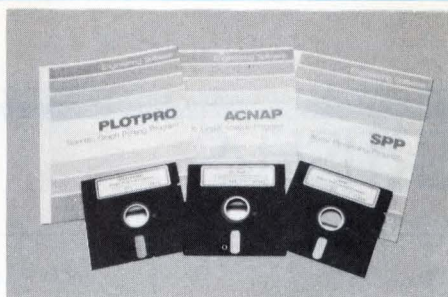
PORTABLE ASSEMBLER PACKAGE 281



WHEN TRIPPED, IT GLOWS Pop-out button, reflecting ambient light, provides quick alert of circuit overload. Fuse holder size Amlit™ circuit protector snaps into both round and square mounting holes. UL and CSA recognized. Standard button colors are red and dayglo orange. Mechanical Products, Inc., P.O. Box 729, Jackson, MI 49204. Or call 517/782-0391.

AMLIT 2000

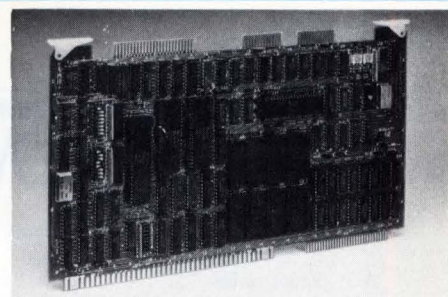
282



AFFORDABLE ENGINEERING SOFTWARE
ACNAP2 Fast Circuit Analysis, 200 parts 30 nodes, chained circuits, I/O impedance, full circuit editor, \$69.95. **DCNAP** DC Analysis, worst-case, power dissipation, \$59.95. **SPP** Transient Signal Processing, FFT, LaPlace, \$59.95. **PCPLOT**-Pixel resolution graphics, linear-log, 2 Y-axes, full labeling, \$59.95. **PLOTPRO** General purpose graph printing, \$49.95. **MSDOS-CP/M-PCDOS-TRSDOS**. **BV Engineering**, 2200 Business Way #207, Riverside, CA 92501 (714) 781-0252

ENGINEERING SOFTWARE

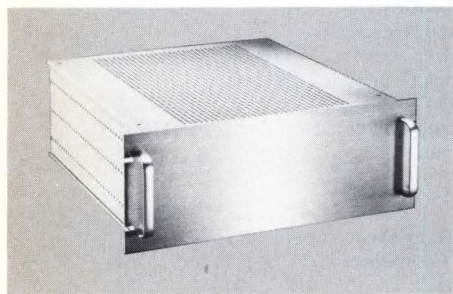
283



Z8000™ MULTIBUS™ SBC Z8001 or Z8002 16-bit CPU (6 MHz); 32K or 128K DRAM (upgradable to 512K); up to 48K static RAM or EPROM; up to 128K EPROM; 2 RS-232 ports (Z8030 SCC); 40 parallel I/O lines, six 16-bit counter-timers (Z8036 CIOs); vectored interrupts. EPROM Debug Monitor, MICRO CURRENT PASCAL, C, FORTH, VRTX. Dev. Z8000 software on IBM PC, PDP-11, Intel MDS, Olivetti M20 or 8080/Z80 CP/M system. Z8000™ Zilog, Multibus™ Intel Corp. SINGLE BOARD SOLUTIONS, 7669 Rainbow Dr., Cupertino, CA 95014. 408-253-0181.

SINGLE BOARD SOLUTIONS

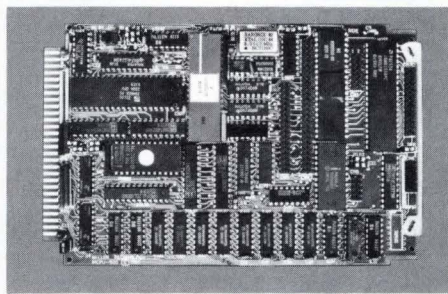
284



HEAVY-DUTY RACK-MOUNT CHASSIS
STRONGBOX™ Heavy-Duty Aluminum Chassis at reasonable prices, from \$178.00! • 4 EIA Front Panel Heights • 3 depths: 9½", 12", 19" • Exclusive Depth Extension Kits • Slides, Mounting Panels Available • Perforated or Solid Covers (213) 204-0472; P.O. Box 84508, L.A. CA 90073. In Europe: Rue de la Promenade 9, 2052 Fountainmelom, NE, Switzerland.

STRONGBOX

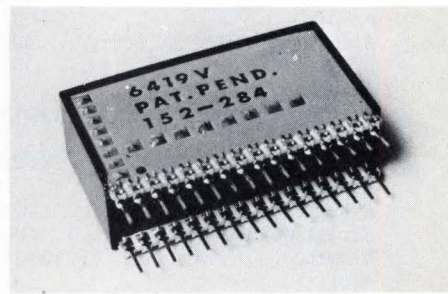
285



Solve virtually all your STD system problems w/a single card. The MCPU-900 provides 4 MHz Z80A, 64K RAM, & up to 16K ROM. 1797 disk controller handles four floppy drives w/all—digital data separator. Also on board are a serial port & 24 bit parallel port that may be used for SASI/SCSI control w/the SASI-100 board. Three 10 MHz counter/timers & Centronics printer port round out the interfacing capabilities. The \$795 price includes 100 hour burn-in & 200 pg. manual. Miller Technology, Inc., 647 N Santa Cruz Ave., Los Gatos, CA 95030, (408) 395-2032.

STD MICROSYSTEM

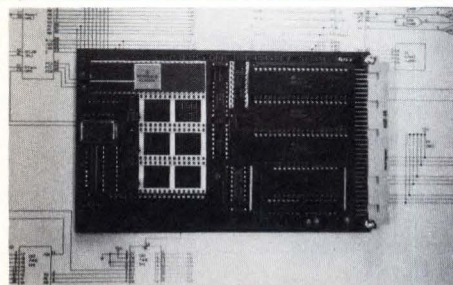
286



HPI-6418V/25618V 64kb/256 kilobyte dynamic RAM module reduces required PC board space by 70% compared to conventional memory modules. This memory module offers lower distributed capacitance, higher speeds & fewer support components. The module operates at a lower temp. & has higher speeds & reliability factor. The HPI-6418V operates on +5 volts & is ideal for computer/telecommunication applications. Units 100% tested. Pricing starts at \$125.00 in 100 piece lots. Hy-Pac Inc., 760 San Aleso, Sunnyvale, CA 94086. (408) 745-0950.

DYNAMIC RAM MODULE

287



68008 Single Board Computer. 100 by 160mm Eurocard. 3 RAM/EEPROM/EPROM sockets for 2K-64K byte devices (2K RAM included). 6 8-bit Bi-Dir I/O ports with handshake and individually vectored interrupts. 4 16-bit timers. Dual async serial RS232 ports. 256b nvRAM. Diagnostics LEDs. Multitasking kernel option. \$295/unit. Quantity discounts available. Heritage Systems Corporation, P.O. Box 10588, Greensboro, NC 27404. (919) 274-4818.

32BIT SINGLE BOARD COMPUTER

288

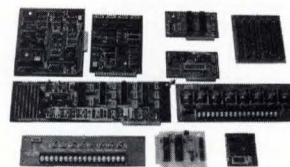


BIVAR EXPANDS LINE OF P.C.B. EJECTORS— Bivar's expansion of CARD-O-PULL™ EJECTORS includes 18 standard printed circuit board ejectors. Economically priced and easy to install for use with 1/16", 3/32" and 1/8" PCB's, CARD-O-PULL™ EJECTORS simplify safe insertion and extraction of PCB's. Complete specifications and pricing are available upon request from BIVAR, INC., 4 Thomas, Irvine, CA 92718. Phone (714) 951-8808.

EJECTORS

289

MICROCOMPUTERS AND INTERFACES



We have six single board computers, two video boards and interfaces for the IBM-PC and APPLE IIe computers. You can use our products for security systems, heat control, light control, automated slide show, traffic lights, irrigation systems, home computer systems, automated process control, and robot control just to name a few. OEM prices available. For catalog call or write to: **JOHN BELL ENGINEERING, INC. 400 OXFORD WAY, BELMONT, CA 94002. (415) 592-8411.**

MICROCOMPUTER/INTERFACE CATALOG 290

INDEX OF ADVERTISERS

AGC Electronics 348
 AIE Magnetics, div. of Vernitron .. 325
 AMP 158-159, 366-367
 AT&T Information Systems... 220-221
 AT&T Technologies 330-331
 AVX Ceramics Corporation 101*
 Aavid Engineering 426
 Abbott Transistor Laboratories 26
 Adams-Macdonald Int'l. 364
 Advanced Electronics Design..... 235
 Advanced Interconnections..... 384
 Advanced Micro
 Devices... Cover II Gatefold, 432-433
 Aerospace Optics 122
 Airpax Electronics 122
 Alden Products 501
 Altera 344-345
 Amco Engineering 399*
 Ampere Inc. 501
 Amphenol, an
 Allied Company 196-197
 Analog Devices 47
 Anritsu 224-225
 Apex Microtechnology 6
 Aromat 372*
 Arnold Magnetic 418A
 Augat 160-161
 Aval 430

BICC Vero 103*
 BV Engineering 503
 John Bell Engineering 503
 Berger Lahr 375
 Bivar 132, 503
 Bit-3 Computer 466
 Boschert Associates 401*
 Brown Boveri & CIE 108E†
 Bubbl Tec 269
 Buckeye Stamping 502
 Bud Industries, Inc. 316*
 Burndy Corporation 310-311*
 Burr-Brown Corporation..... 171

C & K Components 461
 Caddock Electronics 206
 Career Extra 205
 Central Data 304*
 Cherry Electric 162
 Comlinear 327
 Computer Conversions, Inc. 501
 Contraves 116W†
 Control Data Corp. 217
 Corning Electronics 400*
 Cubit 392*
 Custom Programming 500
 Cypress Semiconductor 213
 4C Electronics 469

D.A.T.A. Books 253
 dy-4 Systems 440
 Daisy Systems 133-135
 Dale Electronics 2, 434-435

DataCon 406*
 Data Display Products..... 219
 Data I/O 44
 Data Instruments 428
 Data Set Cable Co. 502
 Data Translation..... 88
 Datel 193
 Davidge Corp. 86
 Delta Electronics..... 422, 423
 Deltron ... 200, 201-204*, 348, 349-352*
 Densan..... 467
 Dialight, A North American Philips
 Company 368-369
 Die-Tech 426
 Digelec (Wavetek-Digelec) ... 185, 475
 Digital Equipment 32-33
 Dupont Berg Div. 280-281

E-A-O Switch 404*
 EECO 58
 EG&G Reticon 431
 EIP Microwave 332-333
 ERSO 448
 ETA SA 448
 Eagle Magnetics 500
 Eldre Components..... 501
 Electro Scientific Industries..... 359
 Electro Standard Lab. 500
 Emulation Technology Inc. 500
 Energetec Systems 411*
 Enertec Schlumberger .116H†, 116X-Y†
 Epson America 409*
 Equipto. Electronics..... 480
 Esan USA 427
 Exact Electronics
 Dynatech Nevada 251
 Exar 211

Fag S.A. Lausanne 116W†
 Fairchild Digital 173
 Ferranti Electronics..... 101E†
 Filtron 455
 Finmore Incom 426
 Force Computers..... 346-347
 Friemann & Wolf 116W†
 Fujitsu America 130, 131
 Fujitsu Ltd. 116U-116V†
 Fujitsu Microelectronics 301*
 Futaba 215

GTEK, Inc. 502
 Garrett Mfg. 418B
 General Data Products 500
 General Digital 298
 General Electric Co.,
 Semiconductor 258-259
 General Instrument,
 Discrete Semiconductor... 308*, 407*
 General Instrument,
 Microelectronics Div. ... Cover IV, 353
 General Semiconductor 79
 Genesis Microsystems 25
 Gould AMI Semiconductors . 56-57, 177
 Gould Inc.,
 Design & Test Systems Div. ... 38-39

Gould Inc.,
 Recording Systems Div..125, 127, 129
 Guardian Electric Manufacturing
 Co..... 468

HEI 16
 Harris Semiconductor, A Div. of
 Harris Corp. 75, 240-241, 295
 Harting Elektronik..... 116N†
 Heinemann Electric Co. 15
 Heritage Systems 503
 Hettinga Inc. 502
 Heurikon 425
 Hewlett-Packard..... 14, 231
 Heyco 318
 Hirose Electric U.S.A. 233
 Hitachi America
 Ltd. 110-111*, 414-415*
 Hughes Connecting Devices 93*
 Hunter & Ready 114-115*
 Hunting Hivolt 116P†
 Hy-Pac..... 503

IBM 277-279
 ILC Data Device Corp. 77
 Ibex Computer..... 464
 Immos 323
 Intel 12-13
 Interconics a unit of BMC..... 336
 Ironics 49
 Ishizuka Electronics..... 472
 Isotronics 458

Janco Corp..... 27

KEC Electronics 447
 Kinematics Truetime 116M†
 Kontron Electronics..... 70-71
 Kwan Chiu 384

Lambda Electronics
 Corp..... 385-388*, 389-390*
 Ledex 419
 Lightwave Communications..... 348
 Linear Technology 179
 Logic Devices 153

MCG Electronics 428
 Magnetics 226
 Marconi Instruments..... 299
 Matra Harris
 Semiconductor 106E-107E†
 Matrox Electronic Systems ... 436, 437
 Mechanical Products 503
 Megatel Computer Technologies ... 500
 Memotech 273
 Mepco/Electra, Inc. 96*
 Meridian Systems..... 501
 Methode Electronics..... 286
 Microbar Systems..... 460
 Micro-craft 501
 Micro Memory 361

INDEX OF ADVERTISERS

MicroSim..... 461
 Microswitch, a Div. of
 Honeywell..... 314-315*
 Microtronics Systems Ple Ltd..... 502
 Midland-Ross, Midtex Div.... 306-307*
 Miller Stephenson..... 391*
 Miller Technology..... 503
 Mill-Max..... 446
 Minato Electronics..... 374
 Minelco, Inc..... 502
 Mini-Circuits Laboratory, a Div. of
 Scientific Components Corp. . 7, 10,
 52, 109, 111, 117-120, 267,
 328-329, 459, 481, Cover III
 Mitel..... 365
 Monolithic Memories, Inc. 40-41
 Mostek Corp..... 87, 300
 Motorola Components..... 282-283
 Motorola Semiconductor Products,
 Inc..... 54-55, 105-107*, 109E-110E†,
 302-303*, 394-395*,
 Multiwire, div. of Kollmorgen 305*
 3M Electronic Products-Textool ... 421

 NCR-Board Level Products..... 376
 NEC America..... 393*
 NEC Electronics..... 94-95*, 98E†
 NJE..... 29
 National Power Technology..... 454
 National Semiconductor
 Corp..... 8-9, 17-24
 Nichicon (America) Corp..... 402*
 Nicolet Oscilloscope..... 30
 Nicolet Paratronics..... 37

 O.K. Industries..... 438
 Oak Switch..... 370-371
 Octagon Systems..... 462
 Olivetti SpA..... 103E†
 Omega Engineering..... 501
 Omron..... 116*
 Optical Electronics..... 375, 377
 Ovensaire-Audio-Carpenter..... 384

 Pacific Microcircuits..... 246
 Panasonic Electronic
 Components..... 309*
 Permag..... 200
 Personal CAD Systems..... 380-381
 Philips Elcoma..... 96E†, 116S-116T†
 Philips Test & Measuring
 Instruments, Inc..... 429
 Pioneer International..... 405*
 Plessey Microsystems..... 169
 Plessey Semiconductor ... 116Q-116R†
 Pocket Technology..... 341
 Policy..... 474
 Pomona Electronics..... 473
 Potrans Electrical..... 426
 Precision Monolithics..... 50, 51
 Pro-Log..... 69
 Pulse Instruments..... 397*
 Pylon..... 450

Quelo..... 502

 RCA Solid State Division..... 154-155
 Racal Recorders..... 313*, 116F†
 Racal-Redac..... 112-113*
 Rantec..... 343
 Raytheon Co..... 34
 Relational Memories Systems..... 293
 Reliability..... 444, 455
 Robinson Nugent..... 354
 Robotrol..... 502
 Rockwell International..... 1
 Roederstein Electronics..... 420
 Rogers Corp..... 291, 500
 Rohde & Schwarz..... 114E†, 116O†

 SGS..... 187, 383
 SGS-ATES..... 94E-95E†, 112E-113E†
 SP America..... 412*
 SAFT America, Inc.
 Advanced Battery Systems..... 239
 Scanbe, Div. of Zero Corp..... 417*
 Schaffner..... 456
 Seeq Technology..... 244-245
 Shugart Corp..... 262
 Sierracin/Power Systems..... 136
 Signetics..... 260-261
 Silicon Systems..... 67
 Single Board Solutions..... 503
 Soltec..... 98*
 Sophia Systems..... 80-81
 Sorensen Co..... 403*
 Sprague Electric Co..... 82, 357, 500
 Sprague-Goodman..... 446
 Stacoswitch..... 424
 Staff..... 476
 Stag Microsystems..... 506
 Standard Microsystems..... 222-223
 Standard Power..... 398*
 Standex Electronics..... 86, 480
 Stantel Components
 (STC Components)..... 175, 445
 Storey Systems..... 410*
 Strongbox..... 503
 Switchcraft..... 85
 Synertek..... 441-443

 TRW Electronic Industry
 Services..... 312*
 TTE, Inc..... 502
 Tadiran..... 28, 275, 317
 Takasago Ltd..... 104E†
 Tauber Electronics..... 447
 Teapo..... 452
 Tech-Etch, Braun Div..... 104*
 Tektronix..... 61-64, 378-379
 Teledyne Crystallonics..... 466
 Teledyne Solid State Products..... 500
 Tenney Engineering..... 200
 Teradyne..... 284-285
 Texas Instruments..... 42-43, 53, 89-92
 Thomas Electronics..... 408*
 Thomas Engineering..... 256

Thomson CSF
 Semiconductors..... 116I-116J†,
 116K-116L†
 Thomson Components
 LCC-CICE..... 105E†
 Times Fiber Communications..... 271
 Toko America..... 418*
 Transwave..... 191
 Triplett Corp..... 121, 321

 U.S. Instrument Rental..... 108*
 U.S. Pixel..... 404*
 Unidak..... 377
 Unimax Switch..... 363
 Union Carbide..... 297
 Unitrode..... 183, 449
 Utitec..... 276

 Videolog Communications..... 413*
 Vishay Resistor Products, a Div. of
 Vishay Intertechnology, Inc. 457
 Volgen Electronic..... 453

 Weidmuller Terminations..... 189
 Westinghouse Semiconductor..... 257
 White Technology..... 68
 Wintek Corp..... 465, 501

 Yokogawa Hokushin Electric..... 451

 Zax..... 198-199
 Zero Corp..... 195*
 Ziatech..... 470, 501
 Zilog..... 156-157, 242-243
 Zytex..... 334-335

Recruitment

Bourns, Inc..... 486
 Career Opportunities..... 492
 Charles A. Binswanger..... 488
 Daisy Electronics..... 490
 Digital Equipment..... 489
 Federal Express..... 494
 Harris Microwave Semiconductor..... 493
 Intel..... 497
 M/A Com Linkabit..... 486
 Motorola Government Electronics..... 491
 Northrop..... 487
 Red Lion Controls..... 484
 Riker Personnel..... 488
 Search Northwest..... 492
 Southwest Technical..... 490
 Sperry Defense..... 488
 Tektronix..... 495
 Tracor Aerospace..... 492
 Visic Memories..... 485

*Advertisers in U.S. Edition

†Advertisers in International Edition



The most
Powerful
Universal
Programmer
in the
World



stag

Stag Microsystems Inc.,
528-5 Weddell Drive, Sunnyvale, CA 94089
Tel: 408-745-1991. Telex: 910-339-9607.



tough attenuators

\$11.95
from (1-49)

one-piece design defies rough handling

Check these features:

- ✓ Each unit undergoes high-impact shock test
- ✓ Available from 1 to 40 dB
- ✓ DC to 1500 MHz
- ✓ Unexcelled temperature stability, .002 dB/°C
- ✓ 2W max. input power (SMA is 0.5W)
- ✓ BNC, SMA, N and TNC models
- ✓ Immediate delivery, 1-yr. guarantee

NEW!

Precision 50-ohm terminations... only \$6.95 (1-24)
DC to 2 GHz, 0.25W power rating, VSWR less than 1.1
BNC (model BTRM-50), TNC (model TTRM-50)
SMA (model STRM-50), N (model NTRM-50)

CIRCLE 132

finding new ways ...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
World's largest manufacturer of Double Balanced Mixers
P.O. Box 166, Brooklyn, New York 11235 (718) 934-4500
Domestic and International Telex 125460 International Telex 620156

*Freq. (MHz)	Atten. Tol. (Typ.)	Atten. Change, (Typ.) over Freq. Range		VSWR (Max.)	
DC-1500 MHz	±0.3	DC-1000 0.6	1000-1500 0.8	DC-1000 MHz 1.3	1000-1500 MHz 1.5

*DC-1000 MHz (all 75 ohm or 30 dB models) DC-500 MHz (all 40 dB models)

MODEL AVAILABILITY

Model no. = a series suffix and dash number of attenuation.

Example: CAT-3 is CAT series, 3 dB attenuation.

- denotes 75 ohms; add -75 to model no.
- denotes 50 ohms

ATTEN	SAT (SMA)	CAT (BNC)	NAT (N)	TAT (TNC)
1	●	●	●	●
2	●	●	●	●
3	●	■	●	●
4	●	●	●	●
5	●	●	●	●
6	●	■	●	●
7	●	●	●	●
8	●	●	●	●
9	●	●	●	●
10	●	■	●	●
12	●	●	●	●
15	●	●	●	●
20	●	■	●	●
30	●	●	●	●
40	●	●	●	●

PRICING (1-49 qty.): CAT (BNC)..\$11.95,
TAT (TNC)..\$12.95,

ROM Leadership

We deliver what our customers need to compete, Worldwide!
For the ROM density, quality, quantity, delivery, and design flexibility you need,
call your nearest Microelectronics Division Sales Office or distributor.

We help you compete®
**GENERAL
INSTRUMENT**



CIRCLE 133